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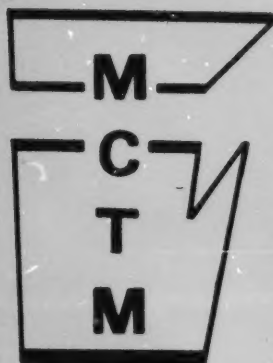
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ABSTRACT

Activities designed to develop reasoning skills with Attribute Blocks are presented. The items are arranged according to age level, however, much overlapping exists between the groupings. The level of the activities ranges from kindergarten through twelfth grade. Some of the items are also viewed as appropriate for prospective elementary and secondary teachers. Each activity is self-contained and is listed with the intended purpose, materials needed, and teaching suggestions. Logical relationships are embodied in observable attributes such as color, shape, and size of the Attribute Blocks. The mathematical ideas that are developed in the activities include: (1) the use of the logical connectives - and, or, not; (2) distinguishing attributes; (3) sequential thinking; (4) problem solving; (5) syllogisms; and (6) pattern recognition. Duplicate pages of activities have been included in the center of the book to be removed, copied, or cut up without destroying the flow of the materials. (MP)

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DEVELOPING REASONING SKILLS WITH ATTRIBUTE BLOCKS

Monograph No. 15
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DEVELOPING REASONING SKILLS
WITH
ATTRIBUTE BLOCKS

BY
JOHN G. VANBEYNEN
ROBERT L. MCGINTY

NORTHERN MICHIGAN UNIVERSITY
MARQUETTE, MICHIGAN

Introduction

The activities found in the monograph are arranged according to age level. However, much overlapping exists between the groupings, and some of the activities are appropriate at several levels. The level of the activities ranges from kindergarten through twelfth grade. Some of the activities are also appropriate for prospective elementary and secondary teachers. Each activity is self-contained. With each activity is found the purpose, the materials needed, and teaching suggestions. By judiciously choosing problems to match the abilities of your students, it is hoped activities from several grade levels can be spiraled into your classroom throughout the year.

The philosophy of the monograph is well stated in a statement by Zoltan Dienes -- "Young children learn best from their own, not other people's experiences." If we want our students to learn logical relationships, these relationships should be embodied in observable attributes such as color, shape, size, etc. Using the activities presented here, the students are gradually led through a series of games that helps a child develop valid reasoning processes. In doing these activities a "dialogue" develops between the materials and the user whereby symbolism and verbalization does not get in the way of the reasoning process.

The mathematical ideas that are developed in the activities include: the use of the logical connectives and, or, not; distinguishing attributes; sequential thinking; problem solving; syllogisms; and pattern recognition. These ideas are introduced in the beginning activities and are gradually extended in the later activities. As the students progress, less use is made of physical materials, and at the upper grade levels, the activities are more abstract.

The Education Policies Commission stated:

The purpose which runs through and strengthens all other educational purposes -- the common thread of education -- is the development of the ability to think.

In order to encourage critical thinking in our students, we must have curricular materials that will help the student develop these abilities. The problems and activities found in this monograph are designed to foster and extend critical thinking by students. In addition, many of the activities are related to other areas of the curriculum so that critical thinking skills are used in other subject areas as well as in mathematics. The students can either work on their own or in small groups. Small groups should be used part of the time so that students experience peer reaction to their reasoning and vice versa.

Many of the ideas and all of the activities in the monograph are original. Two sources stimulated several of the activities, namely Zoltan Dienes' Sherbrook Project and the Comprehensive School Mathematics Project. The authors gratefully acknowledge the stimulation provided by these pioneers.

So that the teacher can use the activities in this monograph without cutting it up, duplicate pages have been included in the center of the book. These pages can be removed, copied, cut up, etc. without destroying the flow of the materials. Each of these duplicate pages is cross referenced with the appropriate activity.

The authors and the Guidelines Committee hope you find this monograph useful. We would appreciate hearing your reactions.

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ACTIVITIES

Introducing the Logic Blocks

One way to introduce the logic blocks to your class is to use the following set of questions. This will enable your students to become acquainted with the materials and allow them to become familiar with the attributes of the blocks.

Color and cut out the pieces in the center section for page

3. After you have cut out the pieces, use them to answer the following questions.

1. How many pieces are there? (24)
2. How many different colors are there? (4)
3. How many different sizes are there? (2)
4. How many different shapes are there? (3)
5. What are the different colors? (Red) (Yellow) (Green) (Blue)
6. What are the two sizes? (Large) (Small)
7. What are the three different shapes called?
(Circle) (Triangle) (Square)
8. Find a piece that is different from the small blue square.
9. What piece did you pick? (answers can vary)
10. How is the piece you picked different from the small blue square? (answers can vary)
11. Find a piece that is different from the large red triangle.
12. What piece did you pick? (answers can vary)
13. How is the piece you picked different from the large red triangle? (answers can vary)
14. These pieces can be different from each other in one, two, or three ways. One difference is shape. What are the other two differences? (color, size)

15. Find a piece that is different in one way from the small yellow square.

What piece did you pick? (answers can vary)

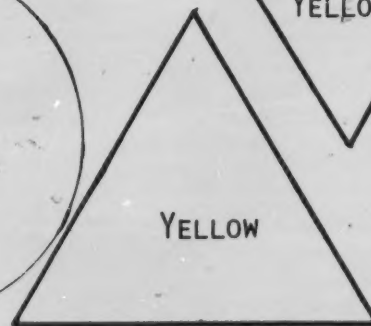
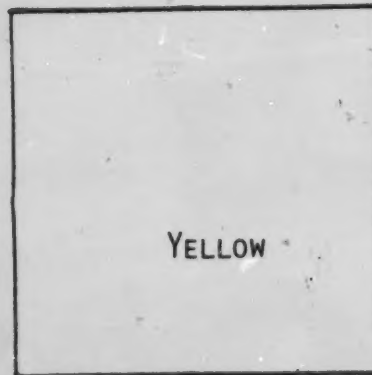
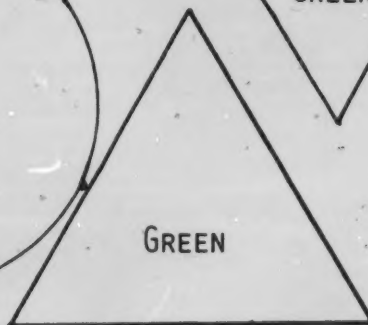
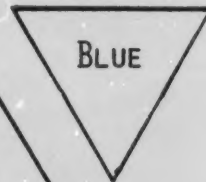
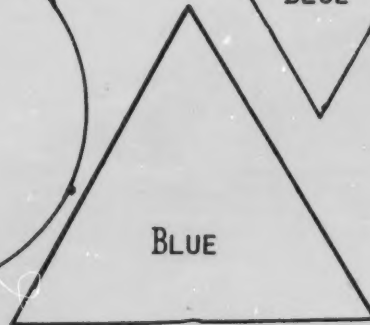
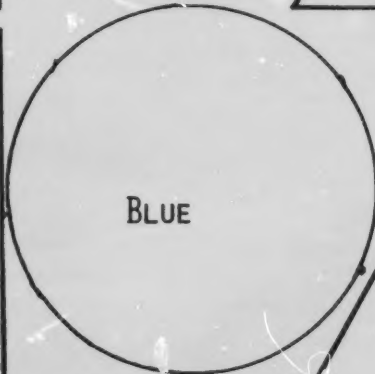
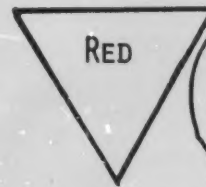
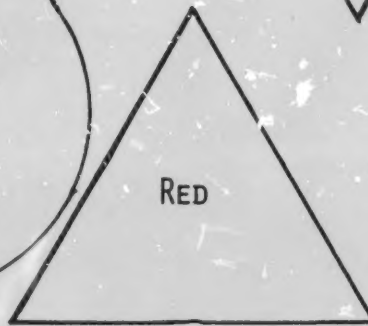
How is it different? (Size, color or shape)

16. Same as question 15 only use in two ways.
17. Same as question 15 only use in three ways.

Try to figure out mentally how many pieces are in each of the sets described below. Check your answers by making the set.

<u>Description of Set</u>	<u>Number in Set</u>
18. All large yellow pieces	(3)
19. All blue triangles	(2)
20. All small pieces	(12)
21. All red pieces	(6)
22. All pieces that are either red or small. (How does this set compare with the sets in 20 and 21?)	(15)
23. All pieces that are both red and small (This is the set of small red pieces)	(3)
24. All small blue circles	(1)
25. All green triangles	(2)
26. All non-green triangles	(6)
27. All green pieces that are not triangles (This is the set of green non-triangles)	(4)
28. All red non-squares	(4)
29. All non-red non-squares (Can finding the number in the set of red squares help you here?)	(16)
30. Challenge problem: All small blue non-circles	(2)

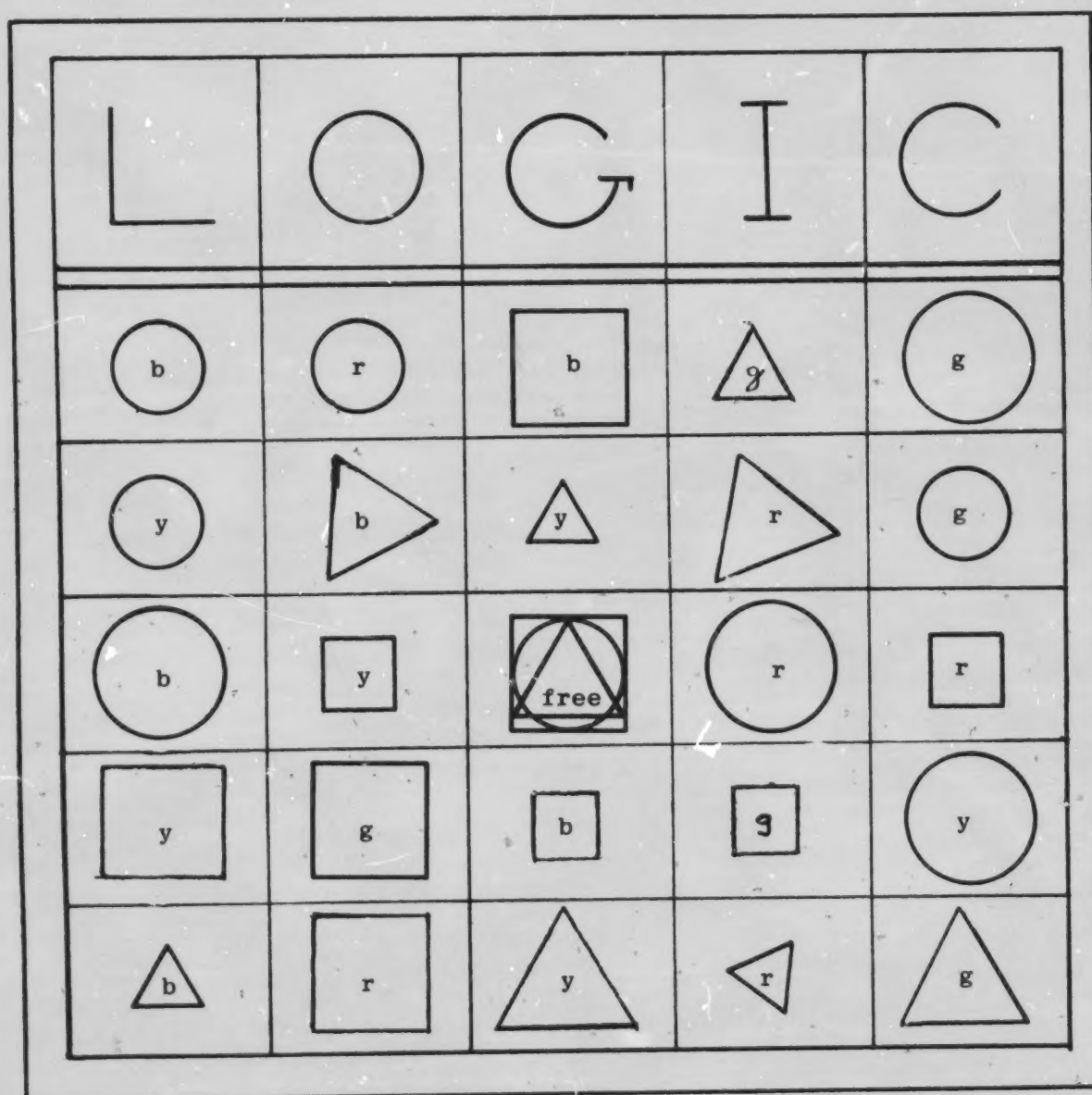
ATTRIBUTE OR LOGIC BLOCKS



Logic

Purpose: Logic/Bingo can be used to test and familiarize the children with the names of the logic blocks. Instead of Bingo we will use LOGIC as the name of our game.

Materials: Using oaktag, make several different cards to look like Bingo (Logic) cards.



The teacher or a student can randomly call out the complete name for each block (a small red square, a large green circle, etc.). The LOGIC players place a chip or marker on each LOGIC square that is the same as the one described by the caller. The first child to cover 5 in a row vertically, horizontally or diagonally calls out "LOGIC."

Fill in the Spaces

Purpose: Develop properties of the blocks and classification and sorting skills.

Materials: A game board like that found on the following page and the attribute blocks. Make the game board large enough to accept the large attribute blocks.

	Red	Blue	Yellow	Green
	Large Small	Large Small	Large Small	Large Small
	Large Small	Large Small	Large Small	Large Small
	Large Small	Large Small	Large Small	Large Small

The students are to place the attribute blocks in the appropriate square. If you want to make a competitive game out of their activity, divide the students into groups of 2 to 4. Place the 24 attribute pieces in front of the students. Each student alternately chooses a block and places it in the appropriate position. If the block is placed in the correct square, then they receive 1 point; an incorrect positioning causes them to lose a turn.

Red	Blue	Yellow	Green
Large  Small	Large  Small	Large  Small	Large  Small
Large  Small	Large  Small	Large  Small	Large  Small
Large  Small	Large  Small	Large  Small	Large  Small



Guess My Name Game

Purpose: To acquaint the students with the attribute blocks and to give them practice in identifying blocks, using geometric terms, and using size relationships.

Materials: All 24 attribute blocks placed in a paper bag.

Number of Players: The entire class

Separate the class into two teams. The teacher selects an attribute block from the bag and hides it in one hand. Teams alternate asking one question about the hidden block. For example, one team could ask: Is the piece blue? The teacher is only allowed to answer the question with a yes or a no. After each question is answered the student asking the question can, if he or she so desires, attempt to name the hidden block. If the student is completely correct in identifying the block and it is the team's first naming attempt, the team receives 10 points. If the student's guess is incorrect the point value is reduced by two points, so the next time a student on the same team wishes to guess, a correct guess is only worth 8 points. The game continues in this manner. The first team to score over 30 points wins.

Remember only the person who is currently asking the question is allowed to guess. Also if the teacher is hiding a large, blue square and the student guesses a blue square, the teacher should remind the student that the answer is incomplete and should be stated again in complete form.

The teacher should also consider having the children take turns at asking questions, otherwise the brighter or more aggressive students dominate the game. It is also likely that students will try to help each other. For the sake of fairness, peer communications should be held to a minimum. Subtract 2 points for peer communication infractions.

A shorter version of the game would be to work with the whole class without a point system. The first student to identify the block can then play the role of teacher.

Additional Similar Activities

1. The teacher walks about the room, allowing one student at a time to draw from the sack and describe the drawn piece, focusing the students' attention on the attributes of size, shape, and color.
2. Pair students to play "Guess my Block". One player thinks of a block, and writes it down where the other player cannot see it. Now have the other player try to guess which piece it is by asking questions that can be answered with only a "yes" or "no". Take turns.
3. This version of "20 Questions" can be played with a small group and a leader.. Make the activity easier by using the pieces, and physically removing those eliminated as a possibility after each question. Question asking becomes more skillful after several rounds have been played. The best question at each play eliminates half the remaining pieces. Such questions are, for example, "Is it large?" or "Is it green or red?" or "Does it have 4 sides?" Using such questions, and not relying on luck, it takes five questions to determine a block exactly.

Who Gets to Go?

Purpose: Basic sorting, classification and matching skills are developed.

Materials: All 24 attribute blocks and the game boards on the following two pages.

Number of Players: One with possibly some adult guidance.

Zoo Game

One day the attribute blocks decide to go to the Zoo to visit their animal friends. In order to get to the Zoo, they have to go through the main entrance and then other gates. The name by the gate tells which blocks can enter by that particular gate. If the block does not meet the requirements of the gate, it will not be allowed to go through and will need to find another gate. For example, red blocks can go through the gate marked "red". Place all those blocks that are allowed to visit their animal friends in the Zoo area.

Disney World Game

This game is similar to the Zoo Game. Notice, some blocks have more than one option. Place all the blocks that are allowed through in the Disney World area.

Copy in Center Section

11.

ENTRANCE

SMALL

RED

LARGE

GREEN

SQUARE

CIRCLE

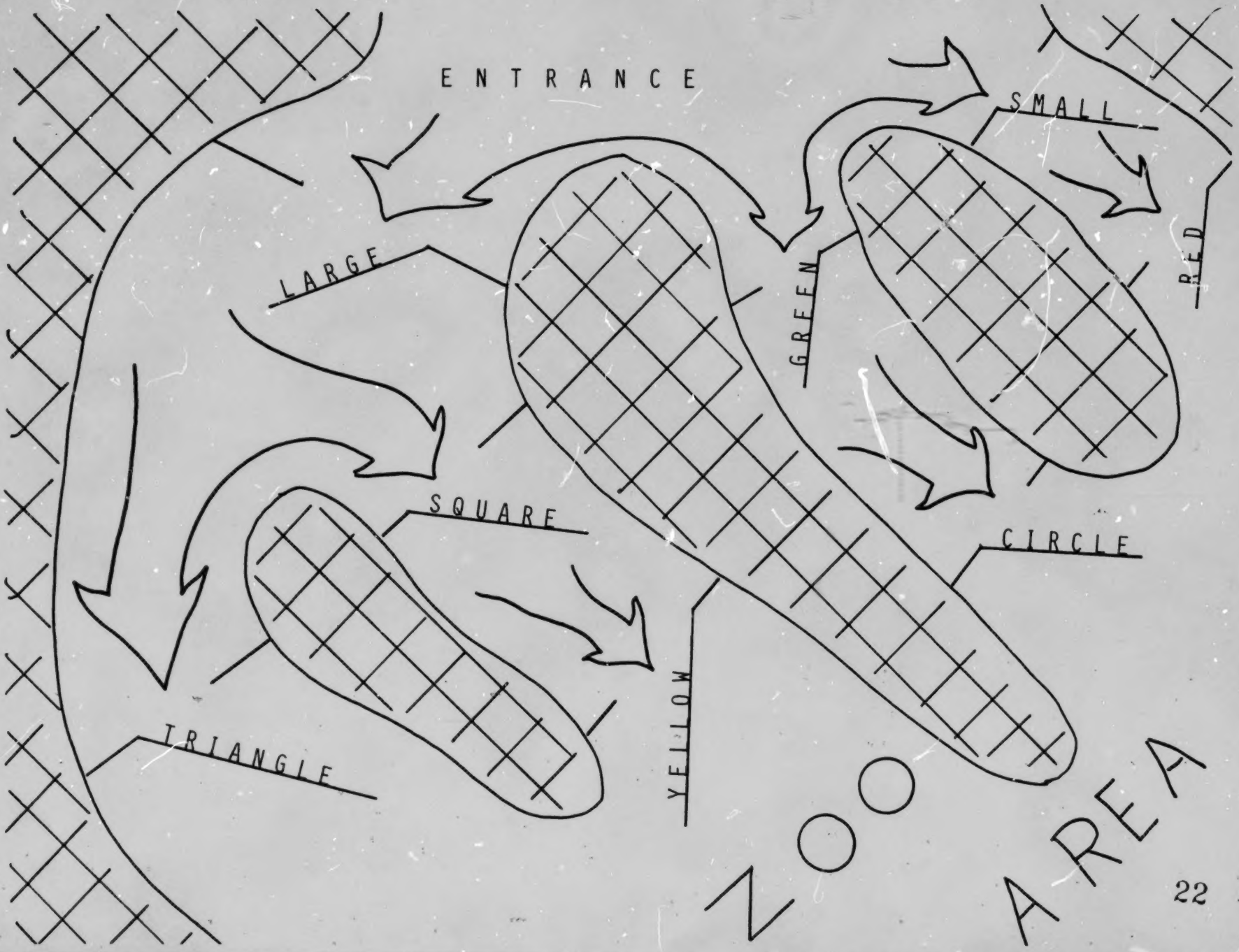
TRIANGLE

YELLOW

ZOO AREA

21

22



ENTRANCE

NOT SQUARE

CIRCLE OR BLUE

SMALL AND RED

LARGE

YELLOW

GREEN

TRIANGLE

DISNEY WORLD

Difference Trains

Purpose: Comparing and contrasting to determine how objects are alike and/or different (the beginnings of logical thinking processes).

Materials: All 24 attribute blocks. (Optional: a train with 24 railroad cars drawn on posterboard.)

Number of Players: Two

Looking at the 24 attribute blocks we see they can be classified in several ways. We can classify them by size (large, small); color (red, blue, green, and yellow); and shape (triangle, square, and circle). If we compare any two pieces, they may be different in exactly one, two, or three ways. For example, a large yellow triangle and a small yellow triangle differ only in size, hence we say they have a "one difference." A large yellow triangle and a small green triangle differ in size and color only, hence they have a "two difference." Since a large yellow triangle and a small green square differ in size, color and shape, they have a "three difference."

Three-difference Train Game

All 24 blocks are placed in front of the two players. The first player selects a block and places it on a table to form the engine of a train. The second player then selects a block that is different in "three ways" from the first block and places it behind the first block. The first player again selects a block that is different in "three ways" from the second block, and places it behind the second block. The players continue to

alternate turns until no other blocks can be placed. The player who places the last possible block wins.

Two-difference Train Game

This game is played like the "three-difference" Train Game except two adjacent blocks must have a "two-difference." This game is more challenging for smaller children since two blocks must be different in two attributes but alike in one attribute.

One-difference Train Game

The game is played like the two previously described games except two adjacent blocks must be different in only one of the three attributes.

These games not only make the child aware of how things are alike and how they differ but also as the game approaches the end the child begins to use a strategy in selecting the blocks to help guarantee that he will place the last block. This ability to think ahead and analyze the consequences of the various choices available is vital to everyday living at all levels of society.

An Introductory Example: The following is a series of questions you might want to try with your class if you feel they need help in understanding the trains.

A one-difference train is started with the large yellow triangle.

How many different pieces can be played next to it?

(6 pieces LYS* LYC SYT
 LGT LBT LRT)

Suppose the small red circle was the first piece. How many different pieces can be placed next to it?

(6 pieces SRS SRT LRC SBC SGC SYC)

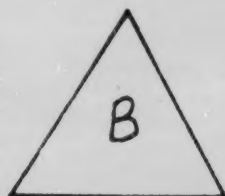
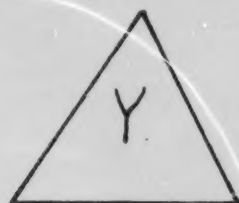
Does the number of possibilities for the second piece depend on what was chosen for the first piece? (no: there are exactly 6 pieces that are one-different from any given piece)

Suppose the first two pieces of a one difference train are:



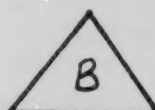
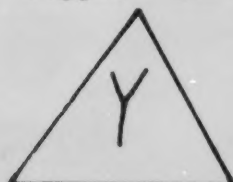
How many different pieces can be placed next? (5 pieces: SRT SYC
 SGT SYS
 SBT)

Suppose the first two pieces are:



How many different pieces can be placed next? What do you notice?
(5 pieces; same number of possibilities as previous problem)
LRT LGT SBT LBS LBC

Suppose the first three pieces are:



How many different pieces can be placed next? Would a different third piece change your answer? What do you notice?

5 pieces: SGT SBC
 SRT SBS
 LBT

The number of possibilities for the 4th piece is the same as for the third piece.

* LYT means large, yellow triangle.

Match Me

Purpose: To develop the concept of similarities, differences, and equivalence.

Materials: A sheet of paper for each child, string, and crayons.

1. The teacher should prepare (or have pupils prepare) enough sheets of paper with logic blocks on them to give one to every child in the class to hang around his neck. The objects should be big enough to be identifiable around the room. Triangles, squares, and circles should be made red, green, blue and yellow. A piece of twine can be passed through the paper to secure the object on the chest of the child.
2. The class should be divided in half with the children standing aside to permit a rather large aisle in the middle. There should be an equal number of the logic blocks on each side of the room. To start the game the teacher holds up one of her copies of a logic block she gave the children and says that she wants an object that is alike in 1) or 2) or 3) ways. The first child who discovers that the card he/she is wearing fulfills the requirements should go to the middle of the aisle and raise his/her arm or sit down. The first child who arrives and does this scores a point for his/her team. The game should have a set goal of 10, 15, or 20 points. This game permits the child to be active and to compete healthily.

EXAMPLE: The teacher holds up a small yellow square so when calling for an object with two similar properties, a person on either team having an object with exactly two of these three attributes could go to the middle to score a point for his/her team. As a variation, use differences instead of likenesses.

3. An alternative method of playing the game would be to have all of the children whose card fulfills the required attributes come to the center. Each child would score a point for his/her team.

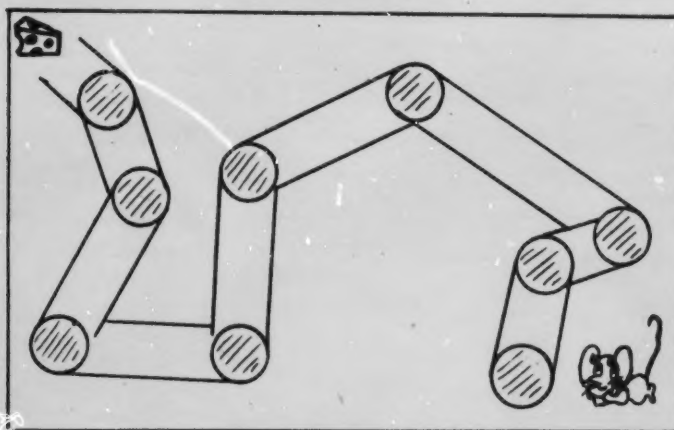
Mouse and Cheese

Purpose: To develop sorting skills and skills in identifying differences.

Materials: 9 of the logic blocks:

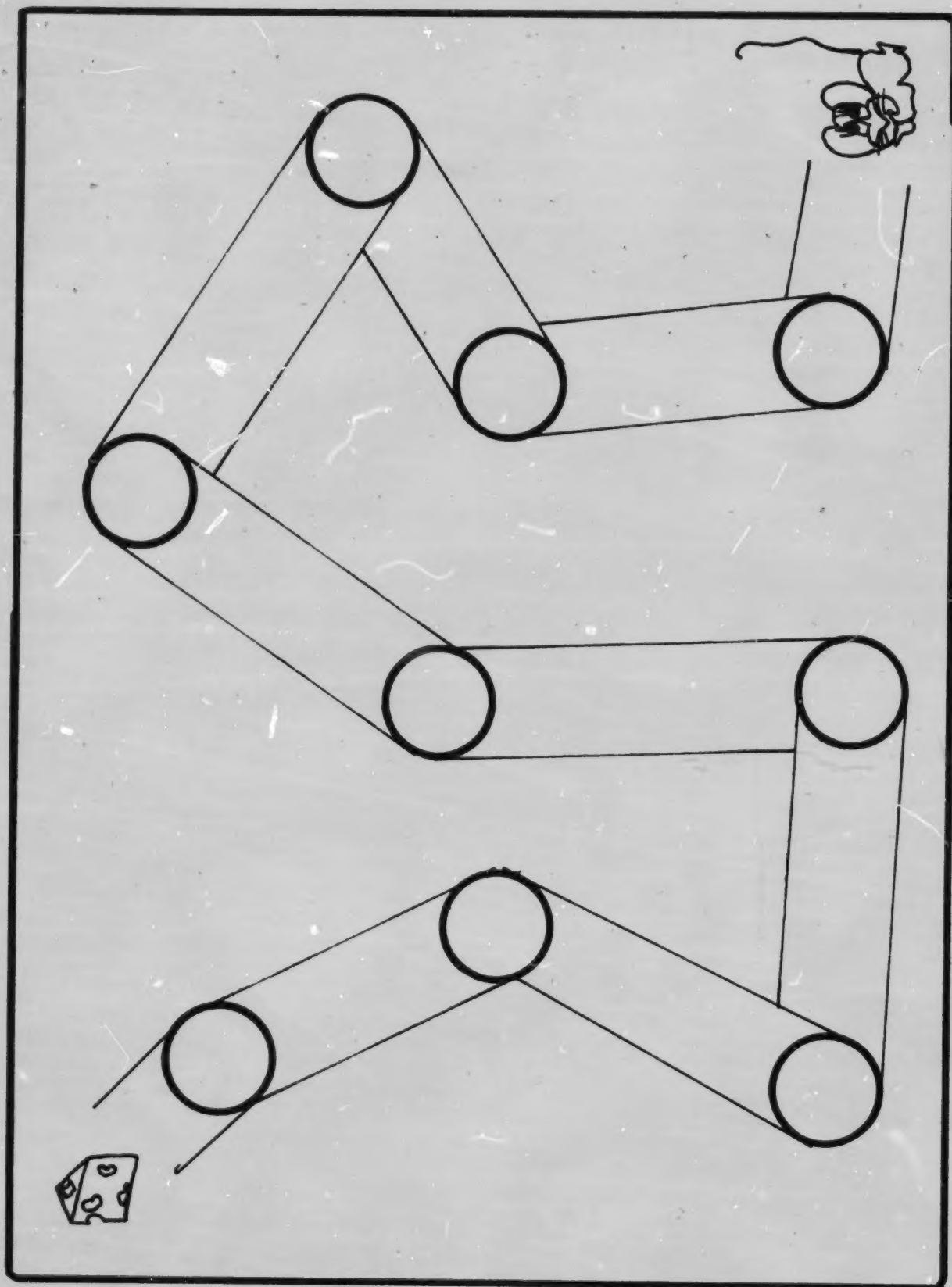
3 green
3 red
3 yellow

1. Make a pile of three green blocks.
2. How are all these blocks alike?
3. Make a pile of 3 red and a pile of 3 yellow blocks.
4. Pick one member from the second pile and tell how it is alike or different from each. Block in that pile.
5. How are all the blocks in the third pile alike? How are they different?
6. With these blocks we will play a game.



We have to help the mouse get to the cheese. Each circle is a gate. In order to open the gate we have to put a block on the gate. Each block must be different in two ways from the block before it. We have nine blocks and nine gates. See if you can be the one who helps the mouse get to the cheese.

NOTE: Teacher should show an example of what she means. These are different in color and shape.



How Does Your Garden Grow?

Purpose: To develop classification and identification skills.

Materials: The 24 Logic Blocks, chalkboard or handouts from the following page.

1. Draw the following diagram:



Tell the children that a farmer lives in the large space called the house. The smaller spaces around the house are the fields for crops. Each space is to have a different plant. Suppose each block is a plant, ask the children to arrange them so that each plant (block) differs in 2 ways from the plant in the next field.

2. Ask children: How are neighboring plants alike?

How are neighboring plants different?

3. The same game can be repeated with pictures of fruits and vegetables, where the children arrange these pictures so that the spaces will differ from the next space in one way.

4. Variations: One can try to go from the end of the path back into the center as well as going from the center to the end.

You can also change the rule from different in one way to alike in one way.



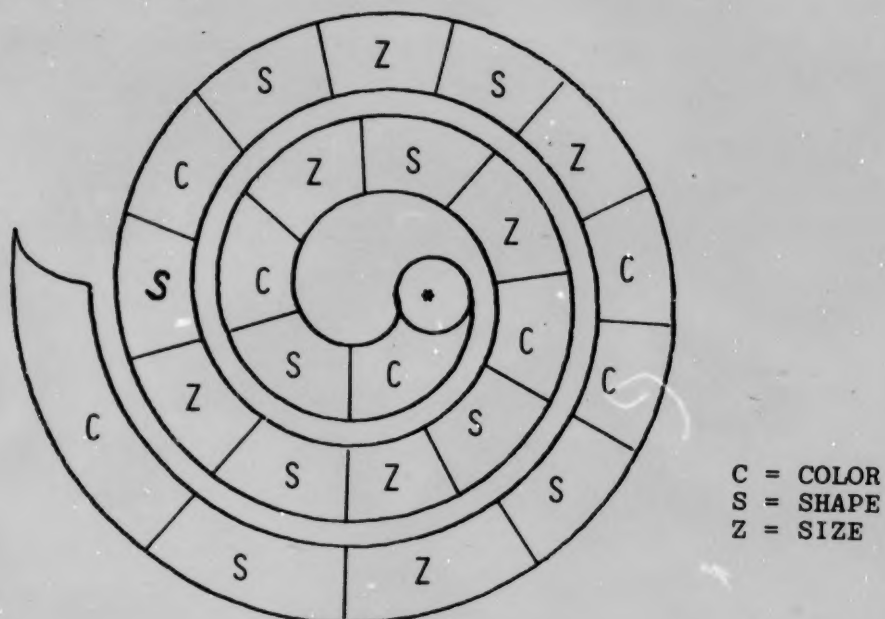
Get Out

Purpose: To develop classification and problem solving skills.

Materials: The 24 attribute blocks.

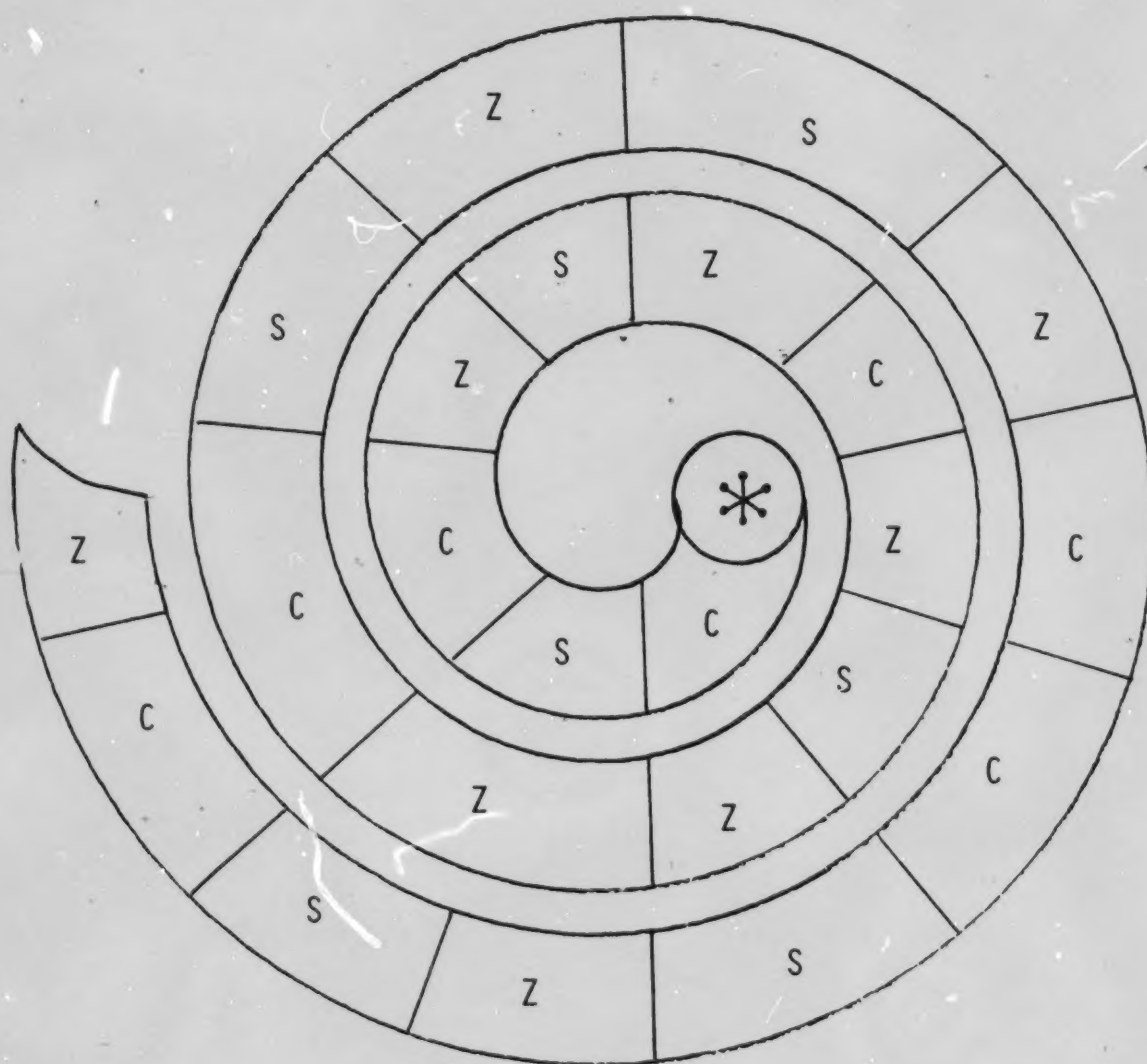
Draw an enlarged version of the configuration below on a sheet of paper, or use handout on page 25.

1. Starting at the center, select any object and place on the starred circle.



2. From here, you must work yourself out by placing blocks on the spaces in accord with the following rule: The next block placed must differ from the previous block in one way - - either color (C), shape (S), or size (Z) as indicated. Once a block is placed it must remain in place.

3. Work from space to space. The student must try to successfully cover every space on the path. If, upon the course of the path, you cannot meet the demand of the space, you must take all blocks off and start over again.
4. Variations: Once can try to go from the end of the path back into the center as well as going from the center to the end.
You can also change the rule from different in one way to alike in one way.

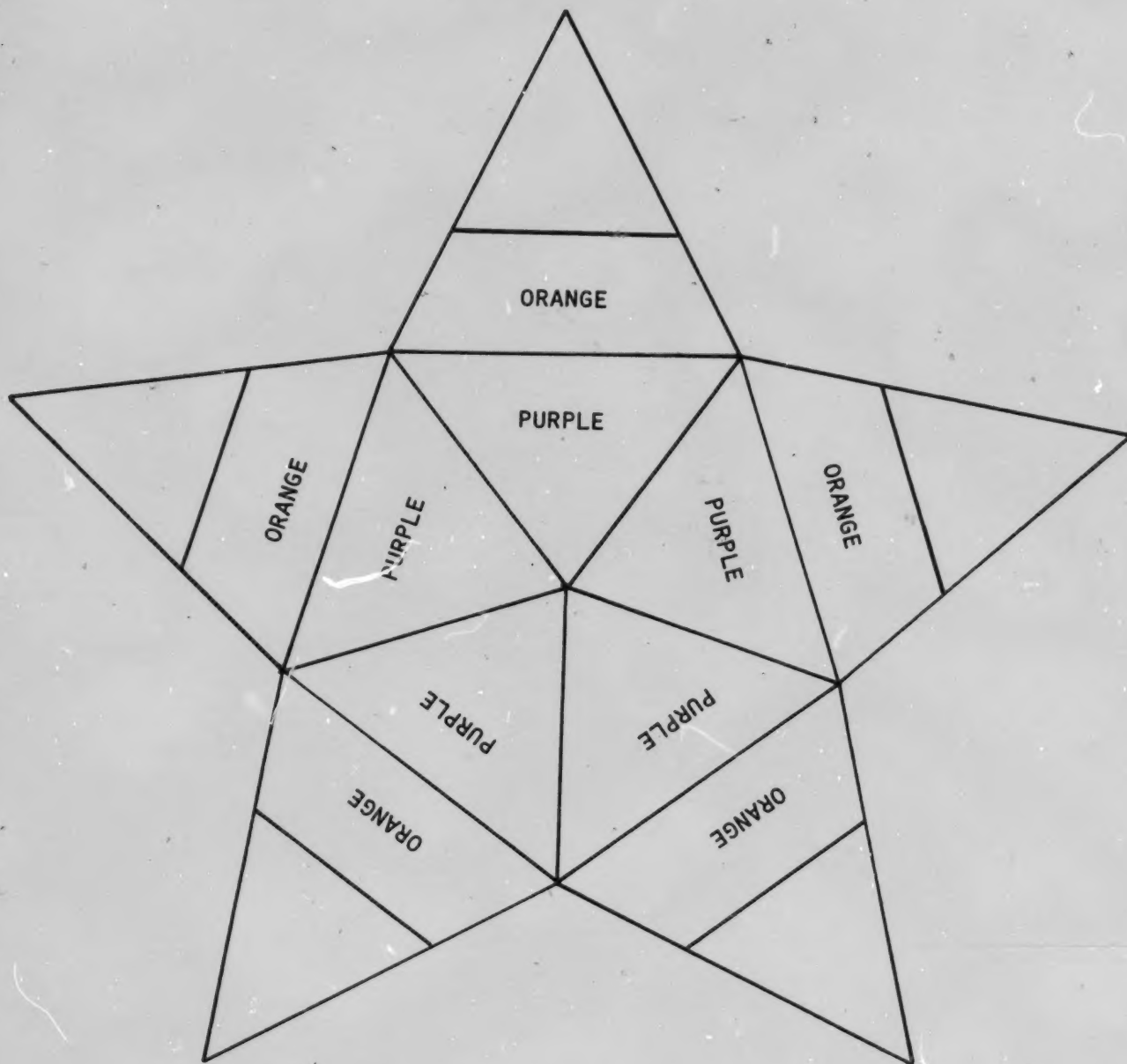


Star War

Purpose: To classify objects on more than one dimension and develop serial thinking.

Materials: The logic blocks and the diagram on the next page.

1. Place a triangle at each point of the star.
2. Place a block in the orange space that is different from the triangle in exactly 2 ways.
3. In the purple space, place a block that is different in exactly two ways from the triangle and two ways from the block in the orange space.

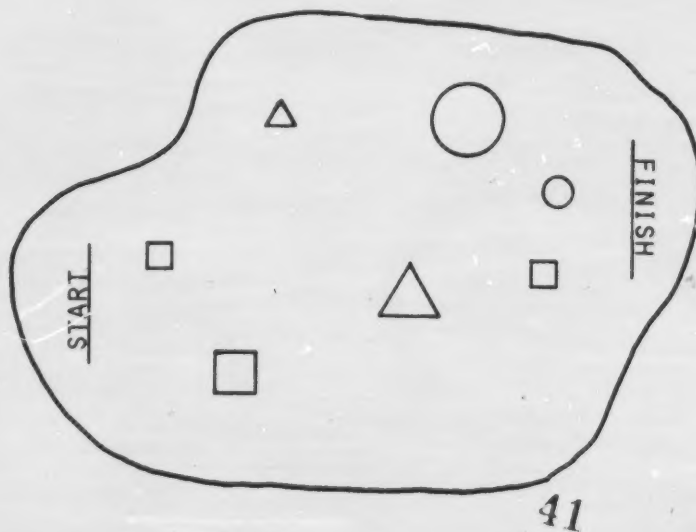


Pond Walk

Purpose: To develop the idea of likeness (equivalence) of objects and classification skills.

Materials: Large piece of blue construction paper and the attribute blocks.

1. Place a large piece of blue construction paper on the floor to represent a pond. Make a line on the right and left sides of the paper, to indicate start and finish.
2. Place some of the attribute blocks on the pond.
3. The player begins at "start" and ends at "finish."
4. The player must walk on all objects that are either alike in color, size, or shape. If a player steps on the wrong object, he falls into the pond. Then he must go to the end of the line.
5. After a player crosses the pond, the class must tell the attribute of objects he stepped on in order to cross the pond.



Difference Games

Purpose: To develop the beginnings of logical thinking.

Materials: All of the attribute blocks and the gameboards on the following pages.

Number of Players: One or Two.

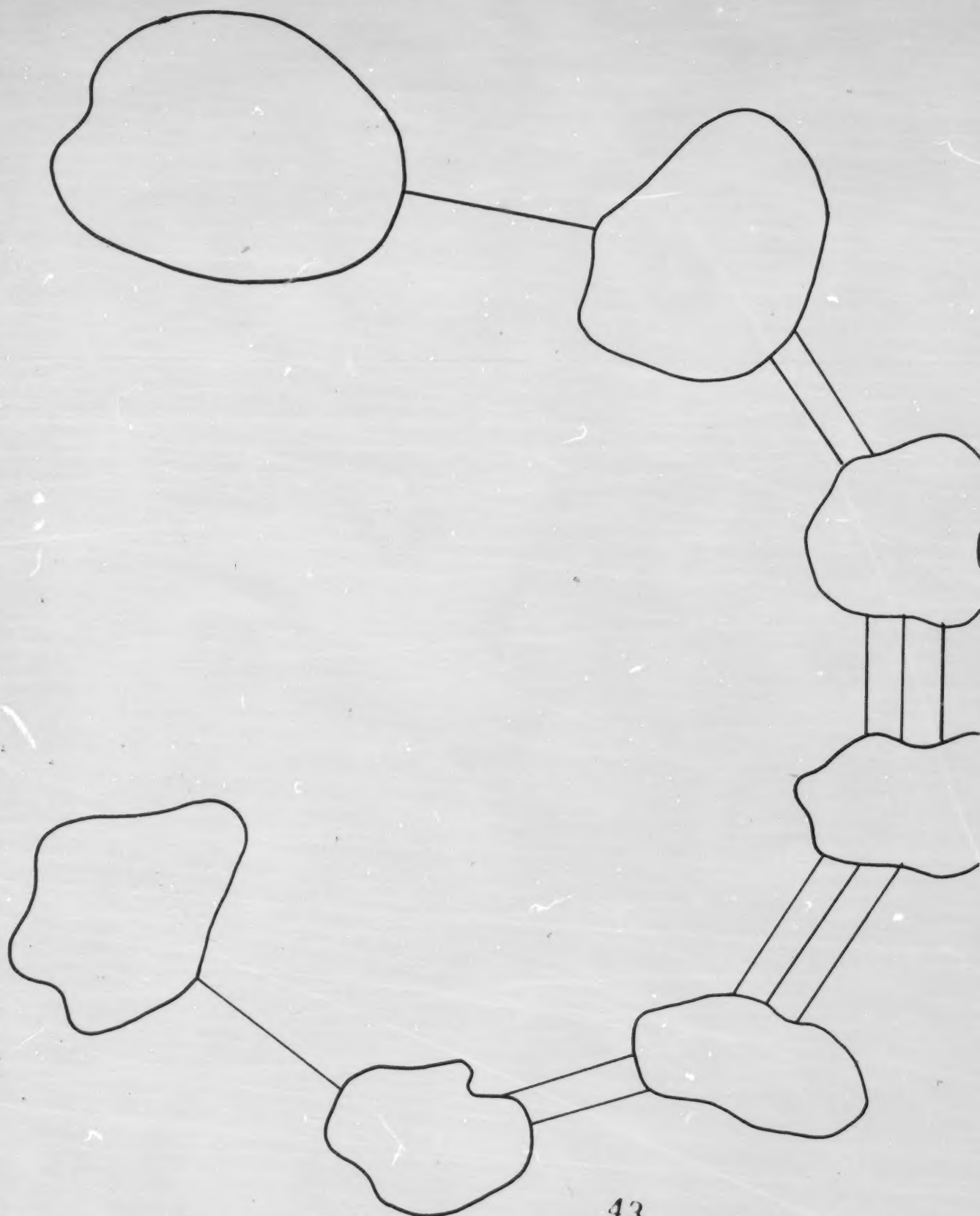
These games are designed to be played by one person; if two students are involved, the solutions are to be obtained through a mutual effort. The games are to be thought of as a puzzle. The object is to place the blocks in the spaces to complete the puzzle.

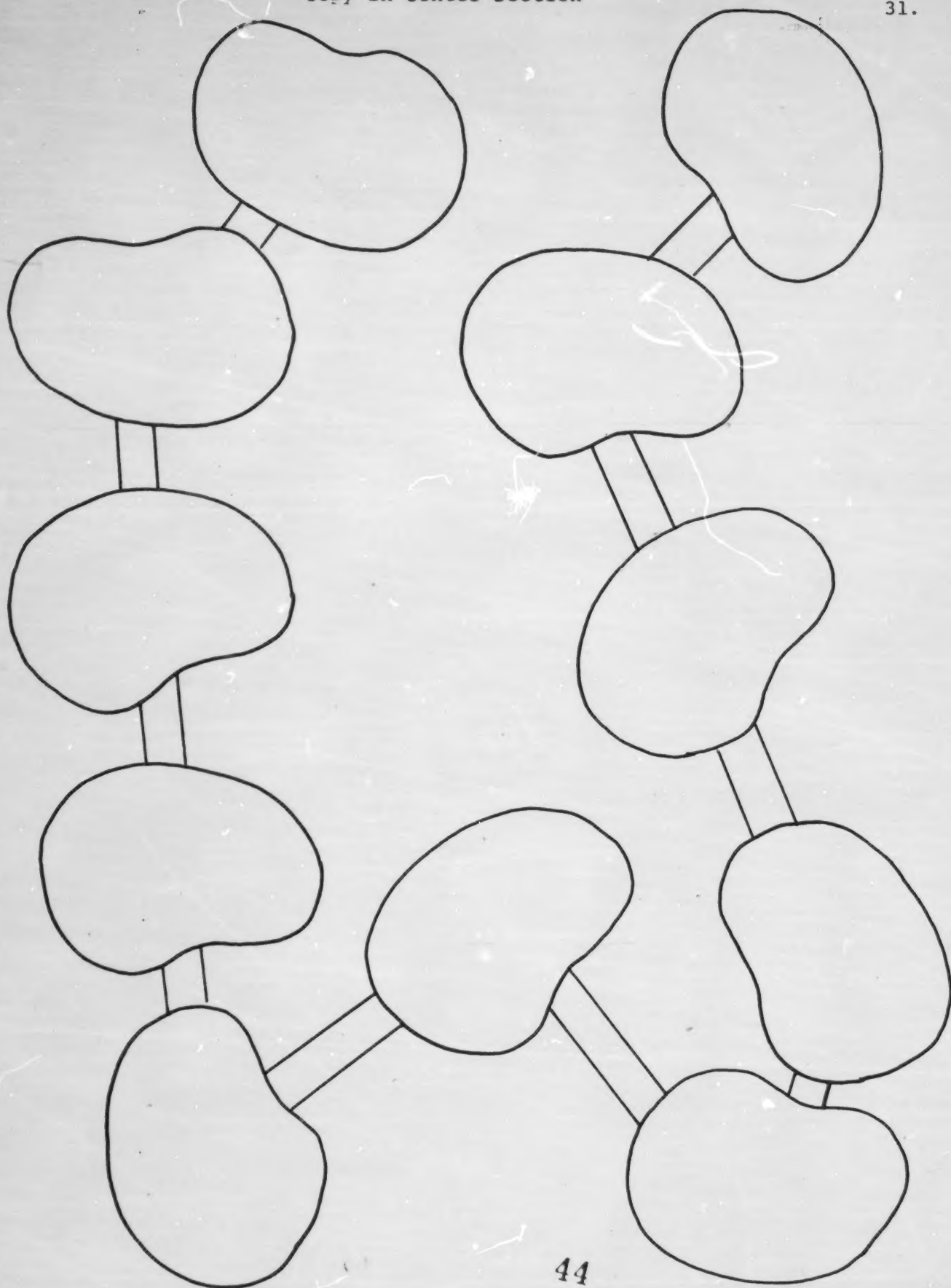
If two spaces are connected by a double line, the blocks occupying the connected spaces must have a "two difference".

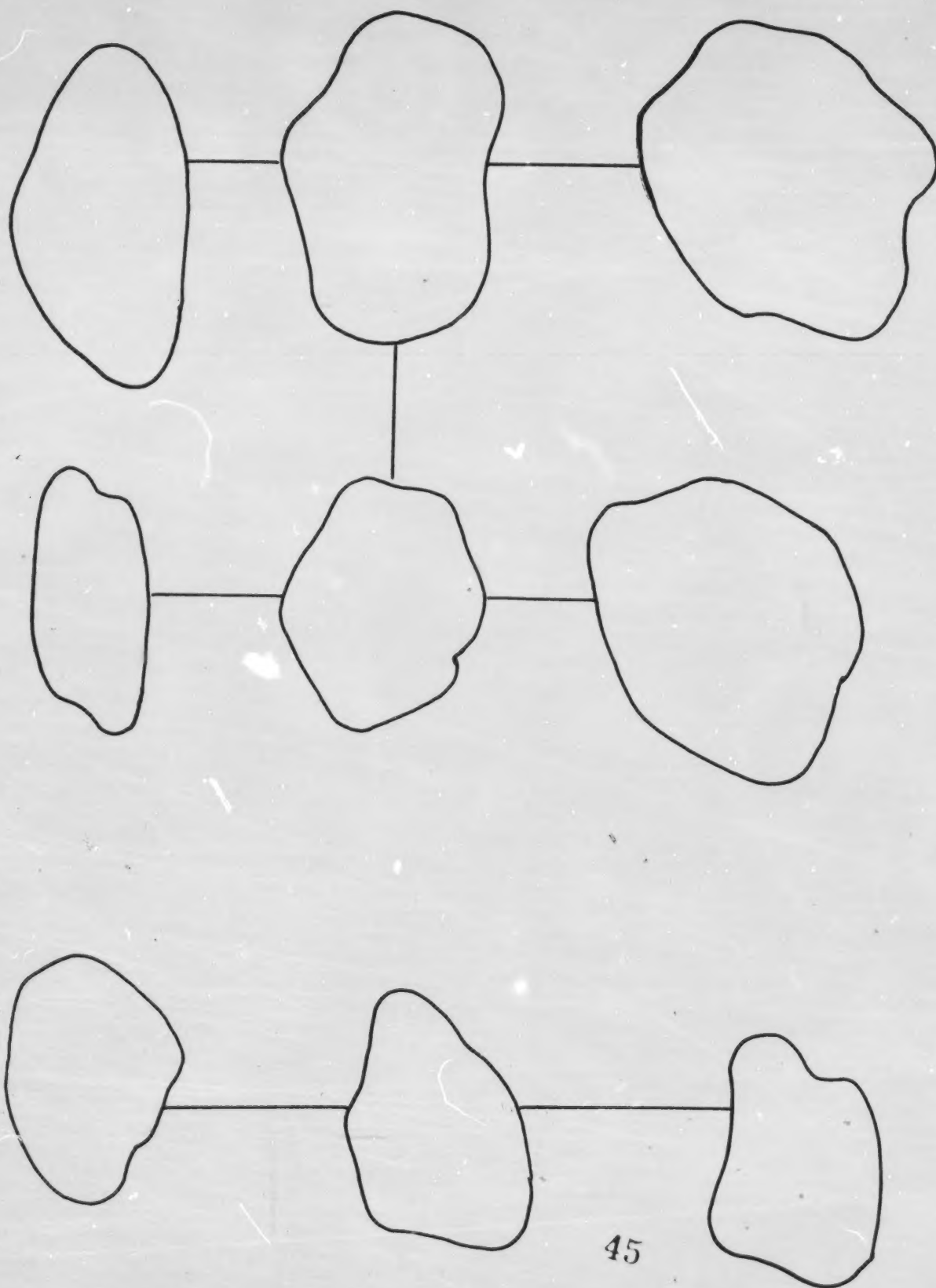
If two spaces are connected by a single line, the blocks occupying the connected spaces must have a "one difference".

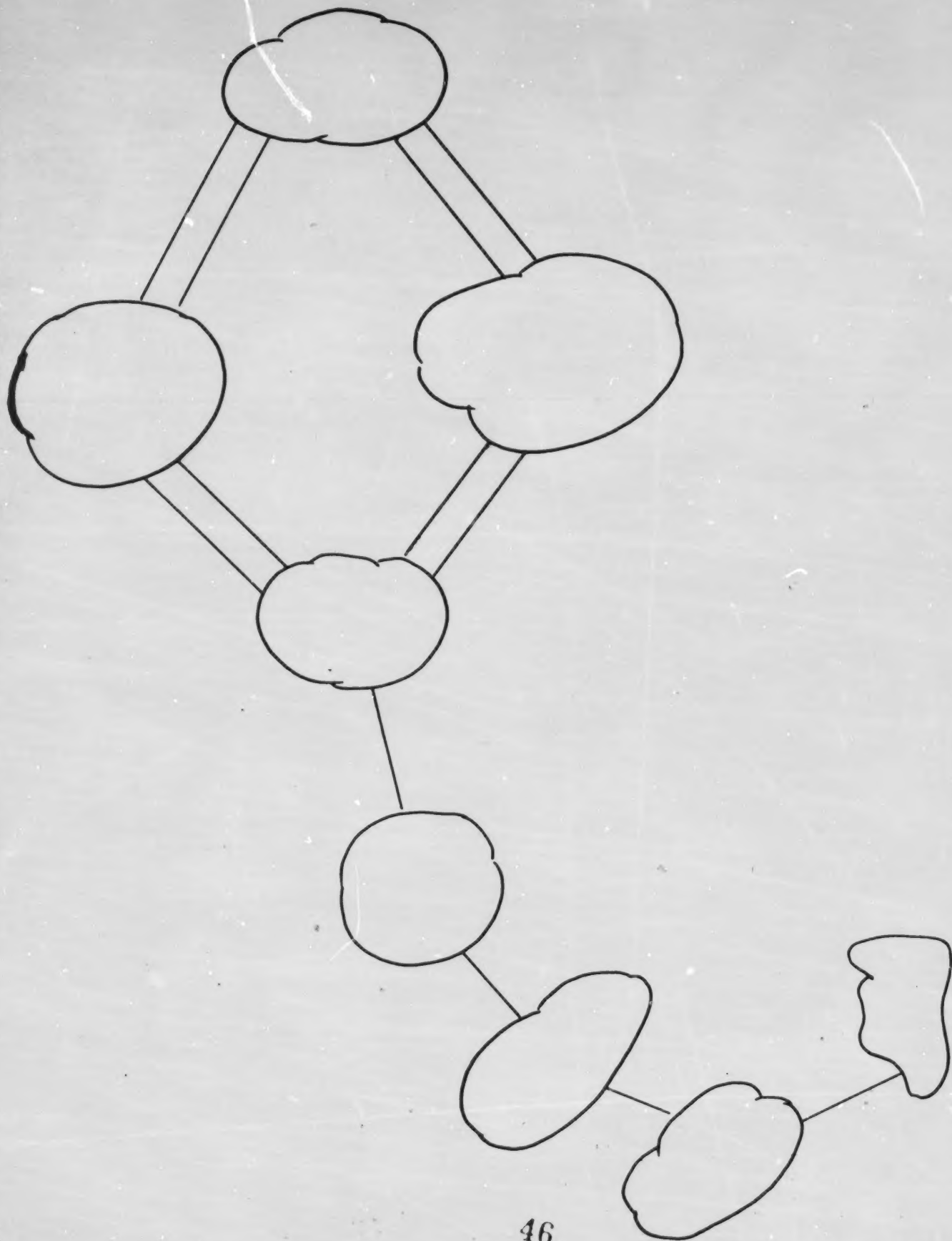
All spaces must be occupied to have a complete solution. The game boards are sequenced from easy to difficult.

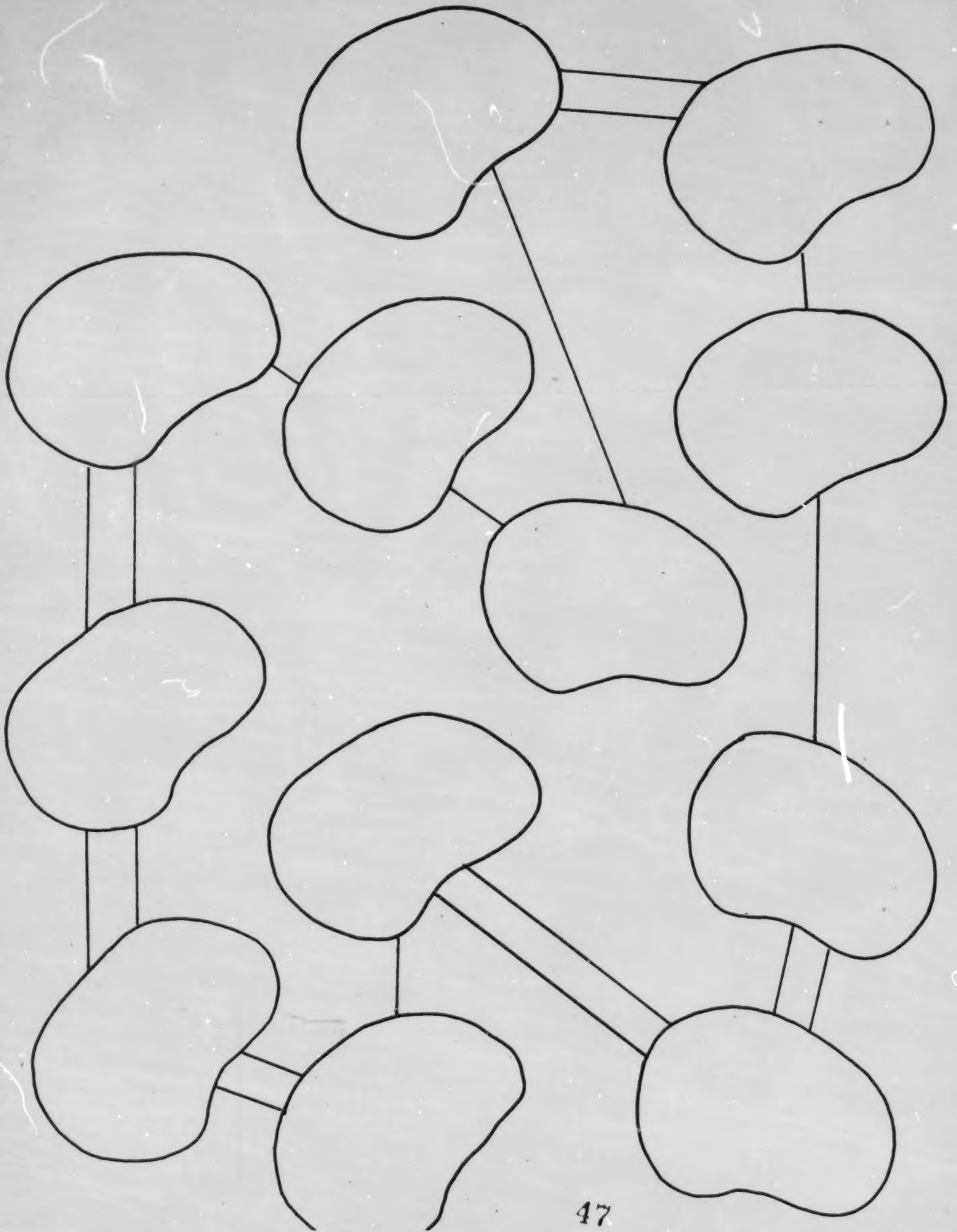
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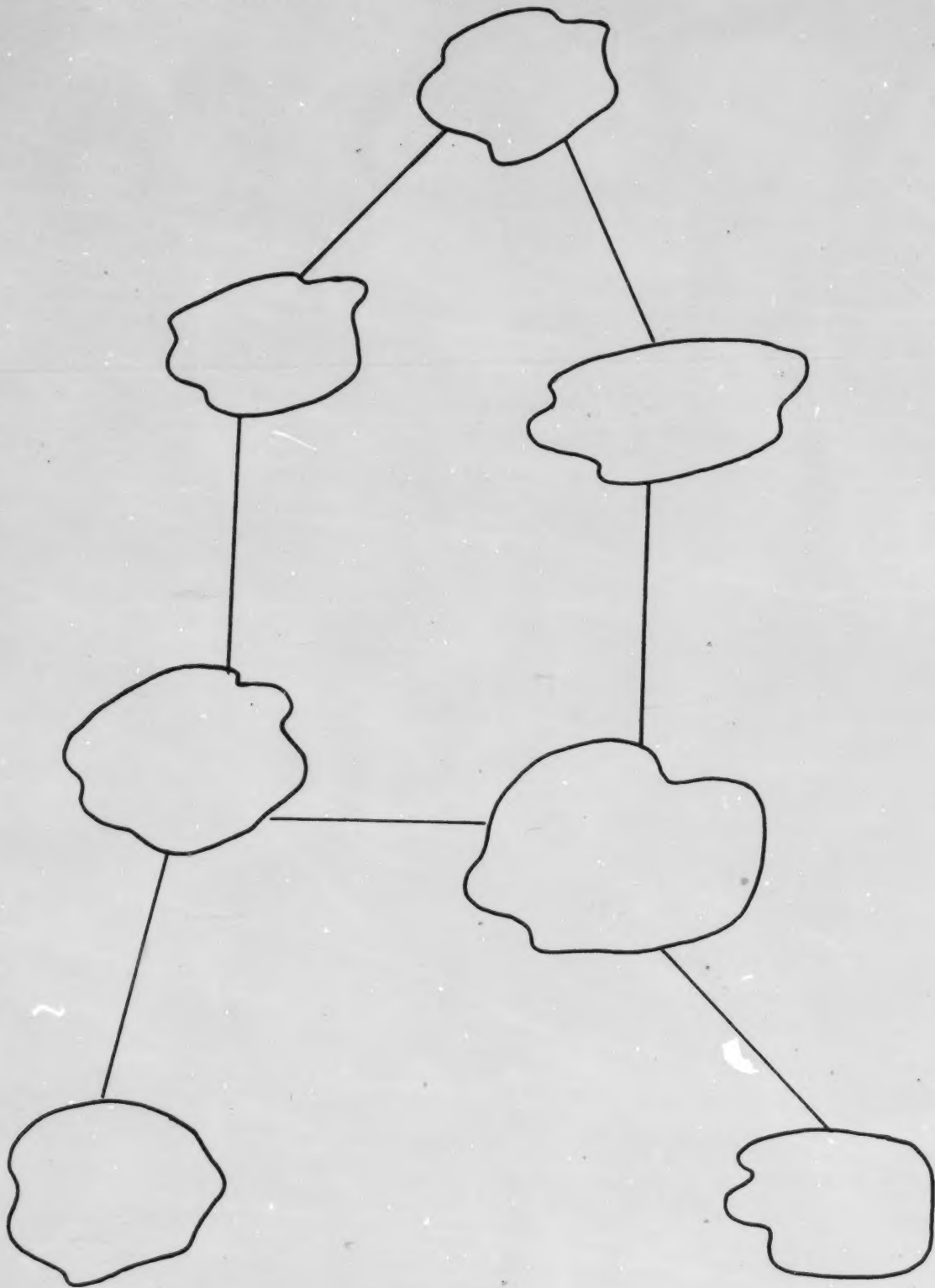










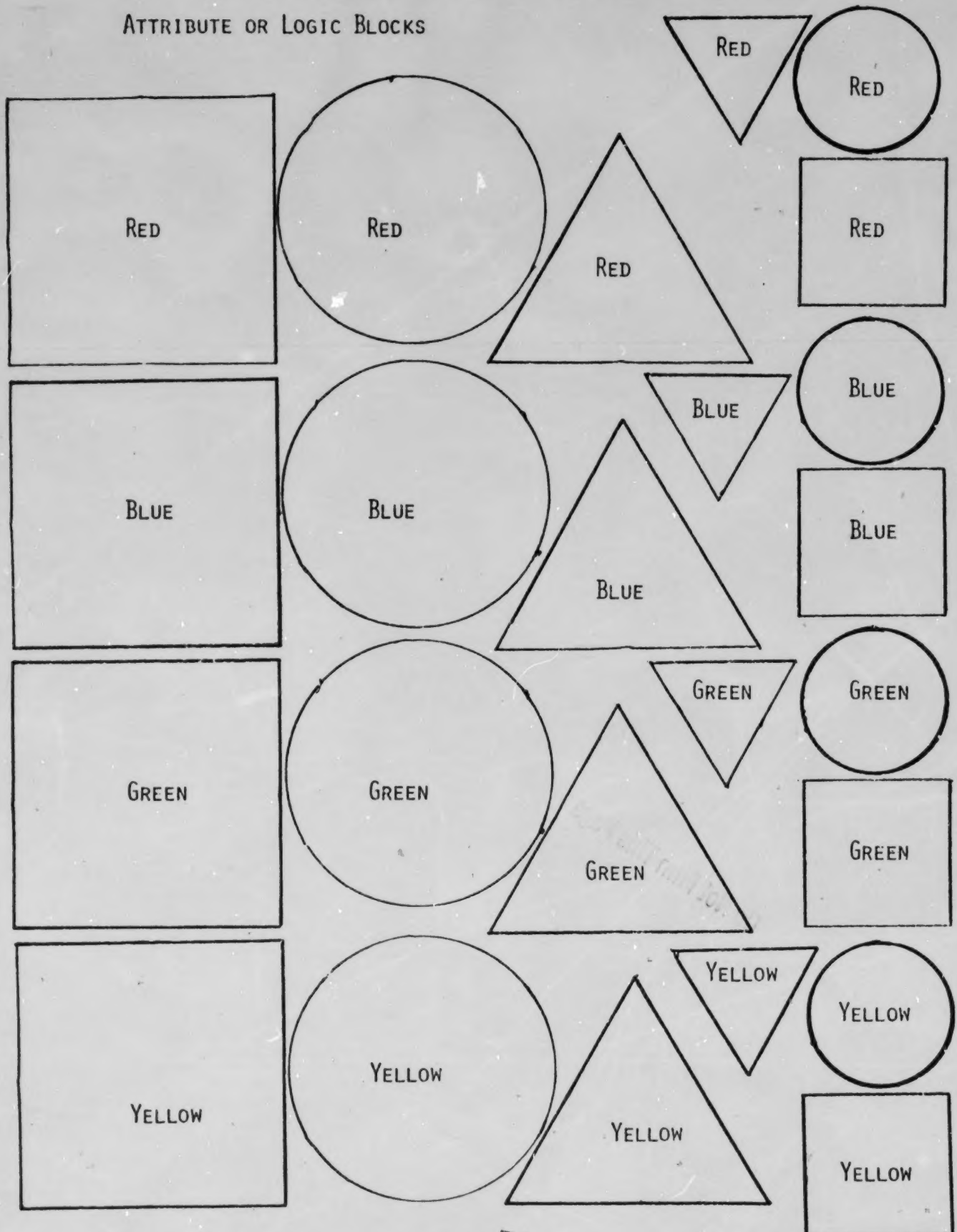


GAME BOARDS
AND
OTHER MATERIALS
FOR
CLASSROOM USE

USE THESE DUPLICATE MATERIALS TO PRODUCE CLASSROOM
QUANTITIES OF ATTRIBUTE BLOCKS, GAME BOARDS AND OTHER MATERIALS.

"Color each shape the color indicated and cut them out."

ATTRIBUTE OR LOGIC BLOCKS



ENTRANCE

LARGE

SQUARE

TRIANGLE

GREEN

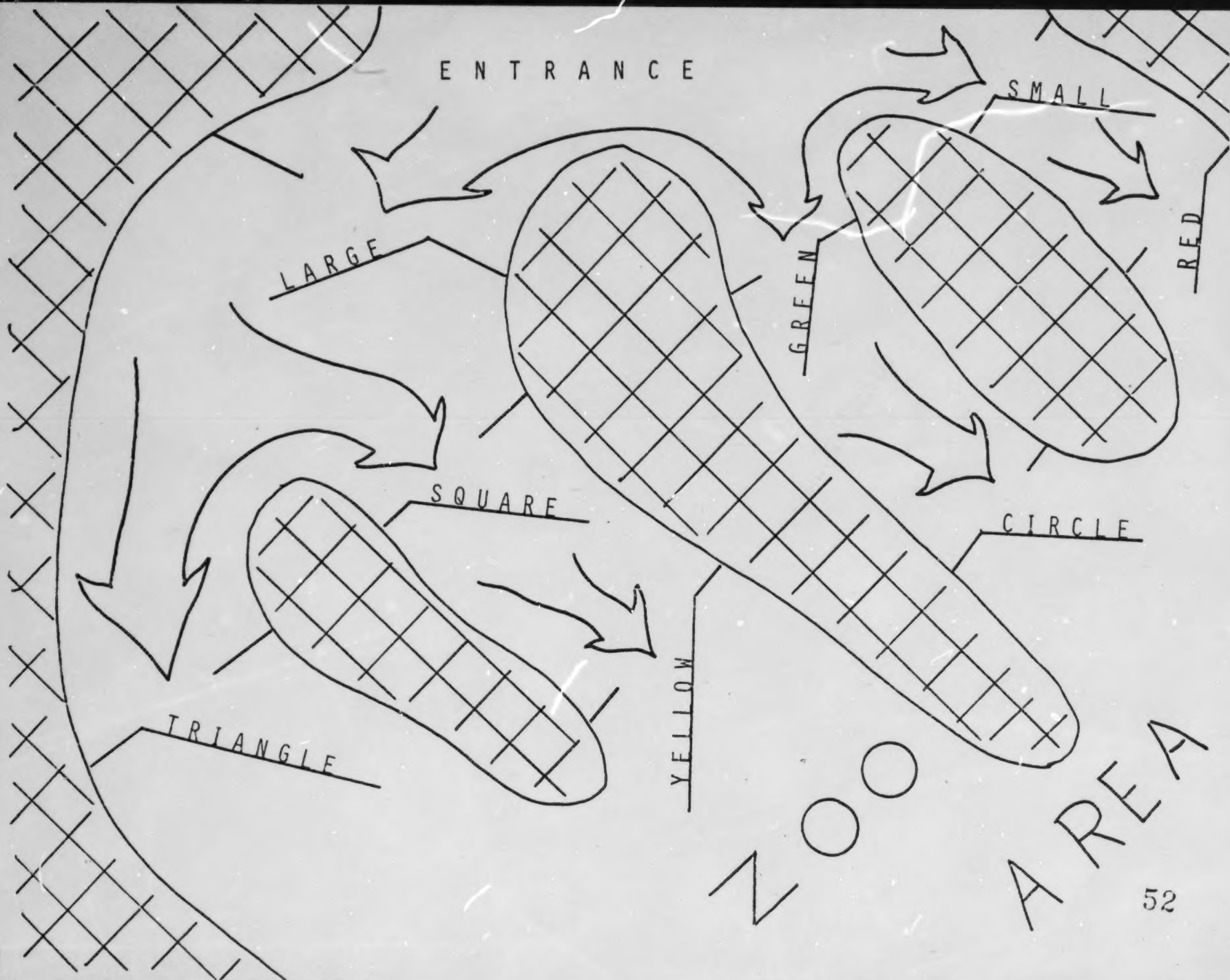
SMALL

RED

CIRCLE

YELLOW

ZOO AREA



E N T R A N C E

NOT SQUARE

CIRCLE OR BLUE

SMALL AND RED

LARGE

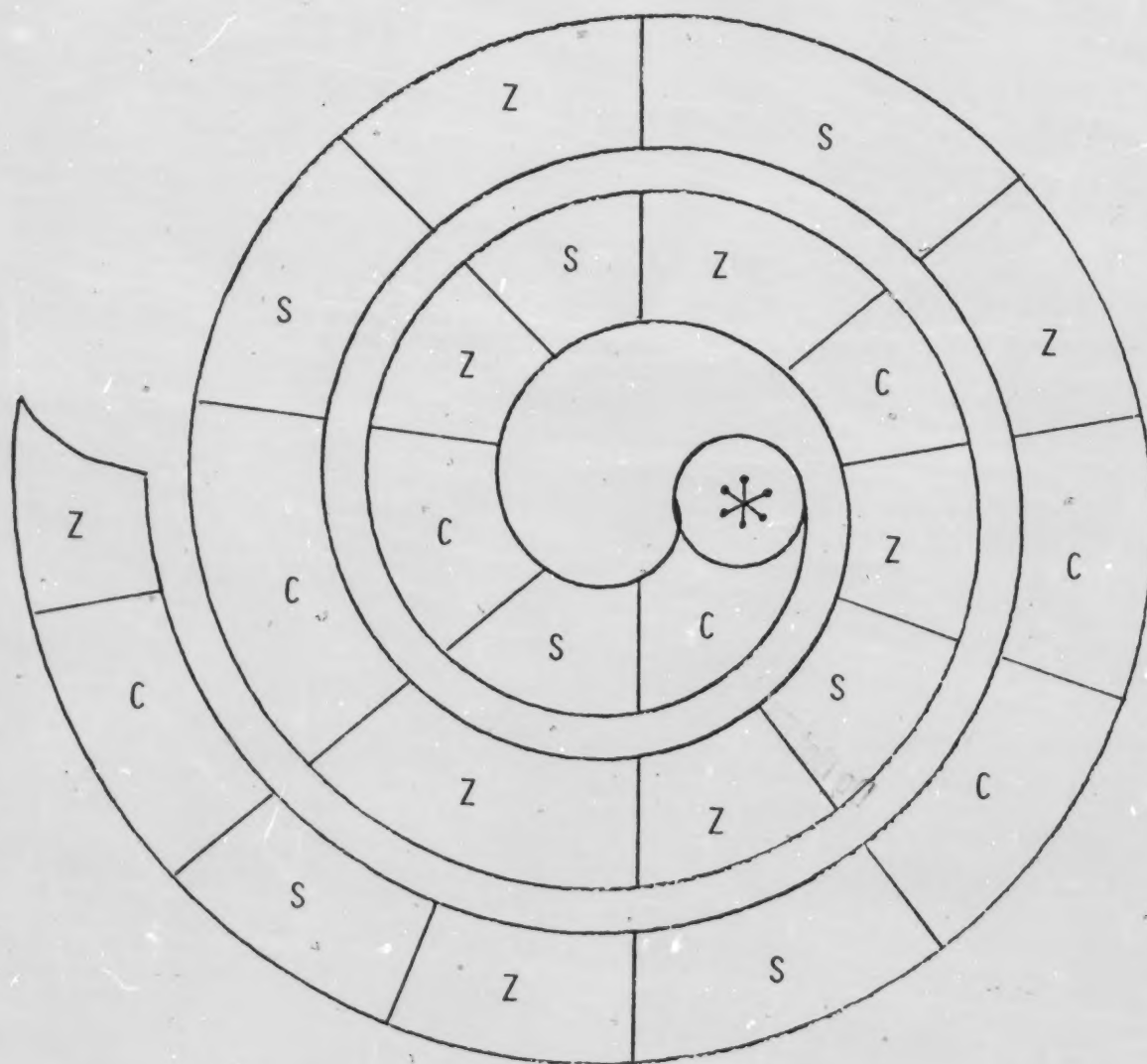
YELLOW

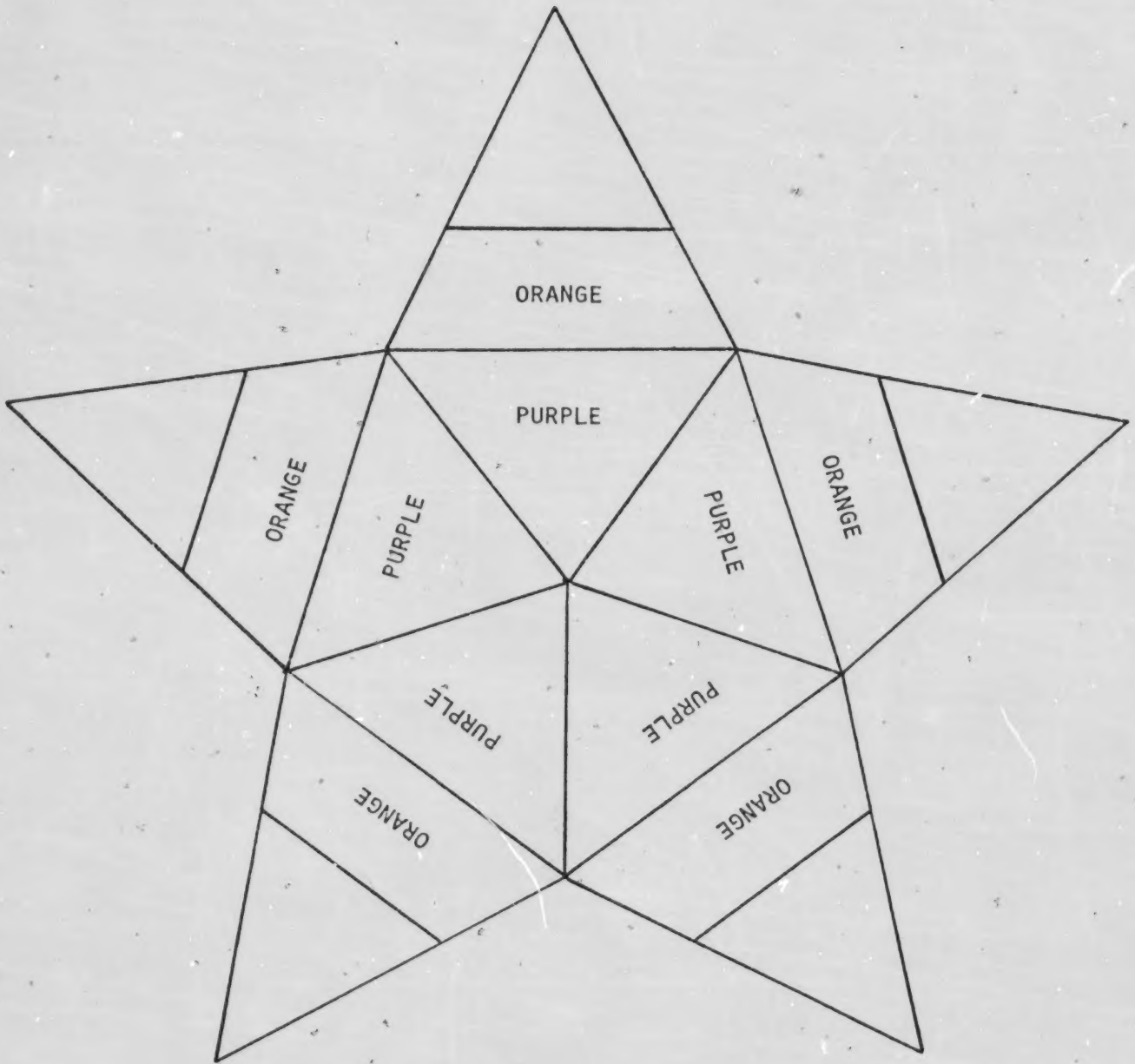
GREEN

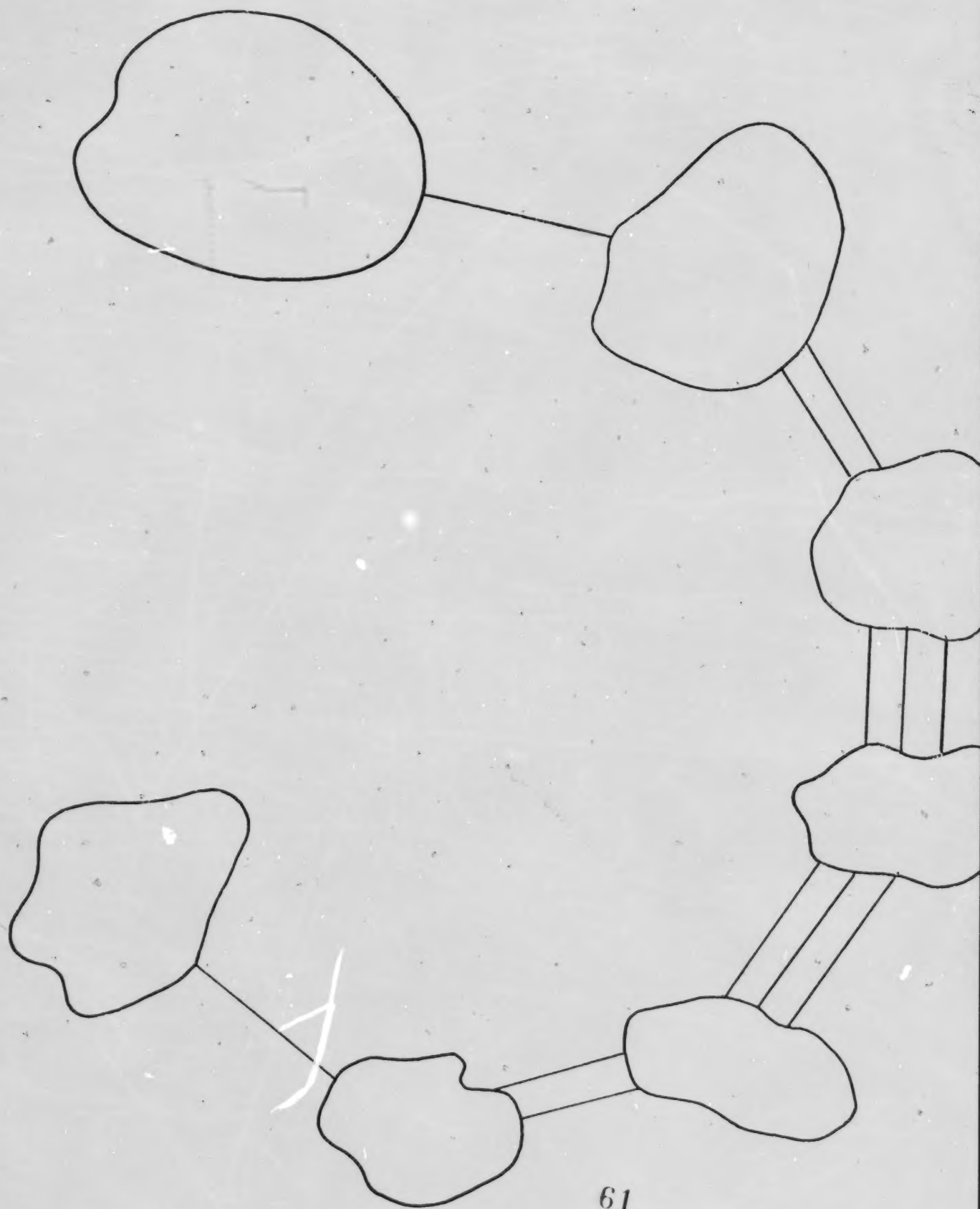
TRIANGLE

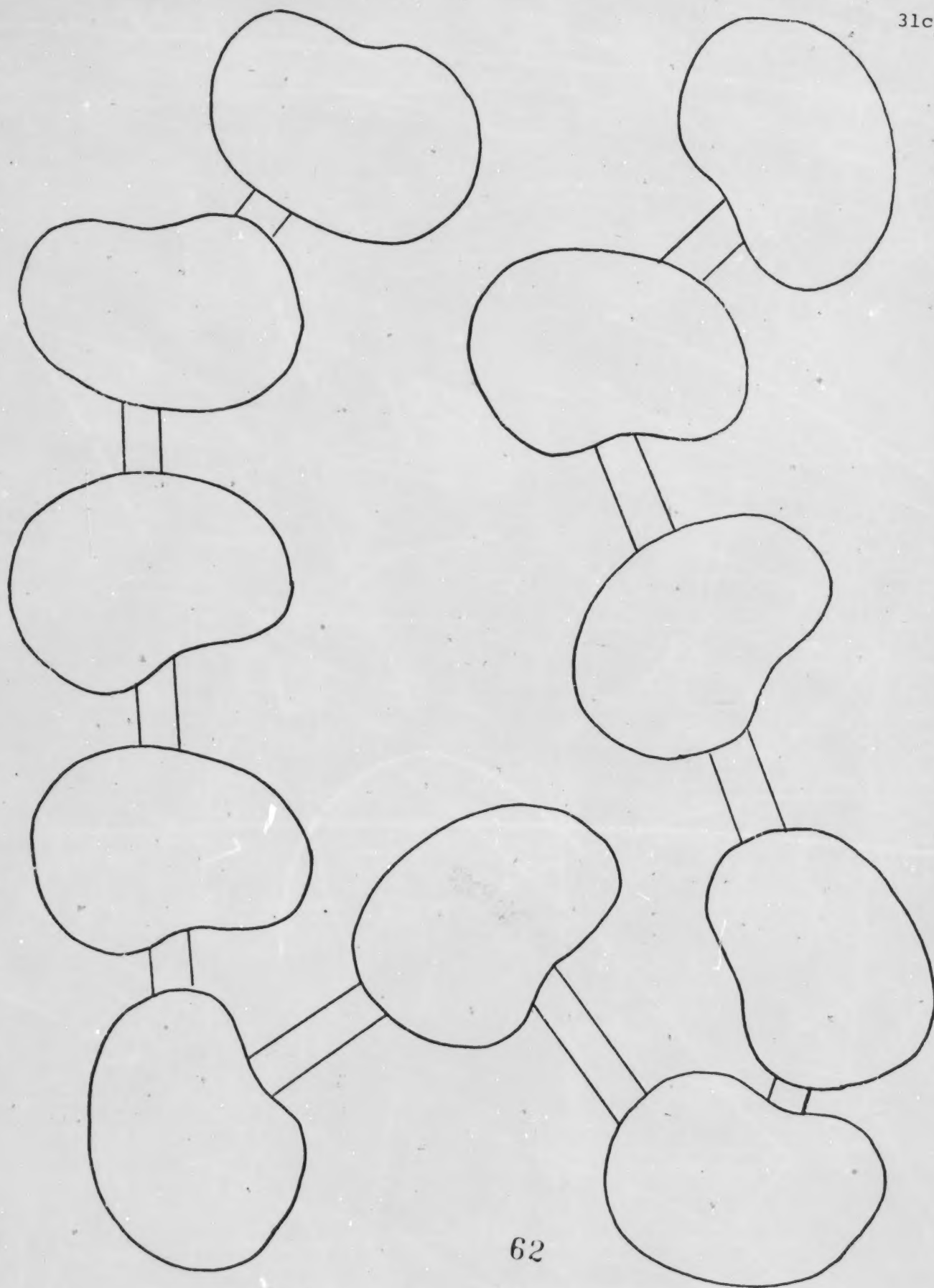
A close-up, black and white photograph of a circular object, likely a coin or medallion. The text "DISNEY WORLD" is visible in a curved path along the top edge of the object. The image is slightly out of focus, showing some texture and wear on the surface.

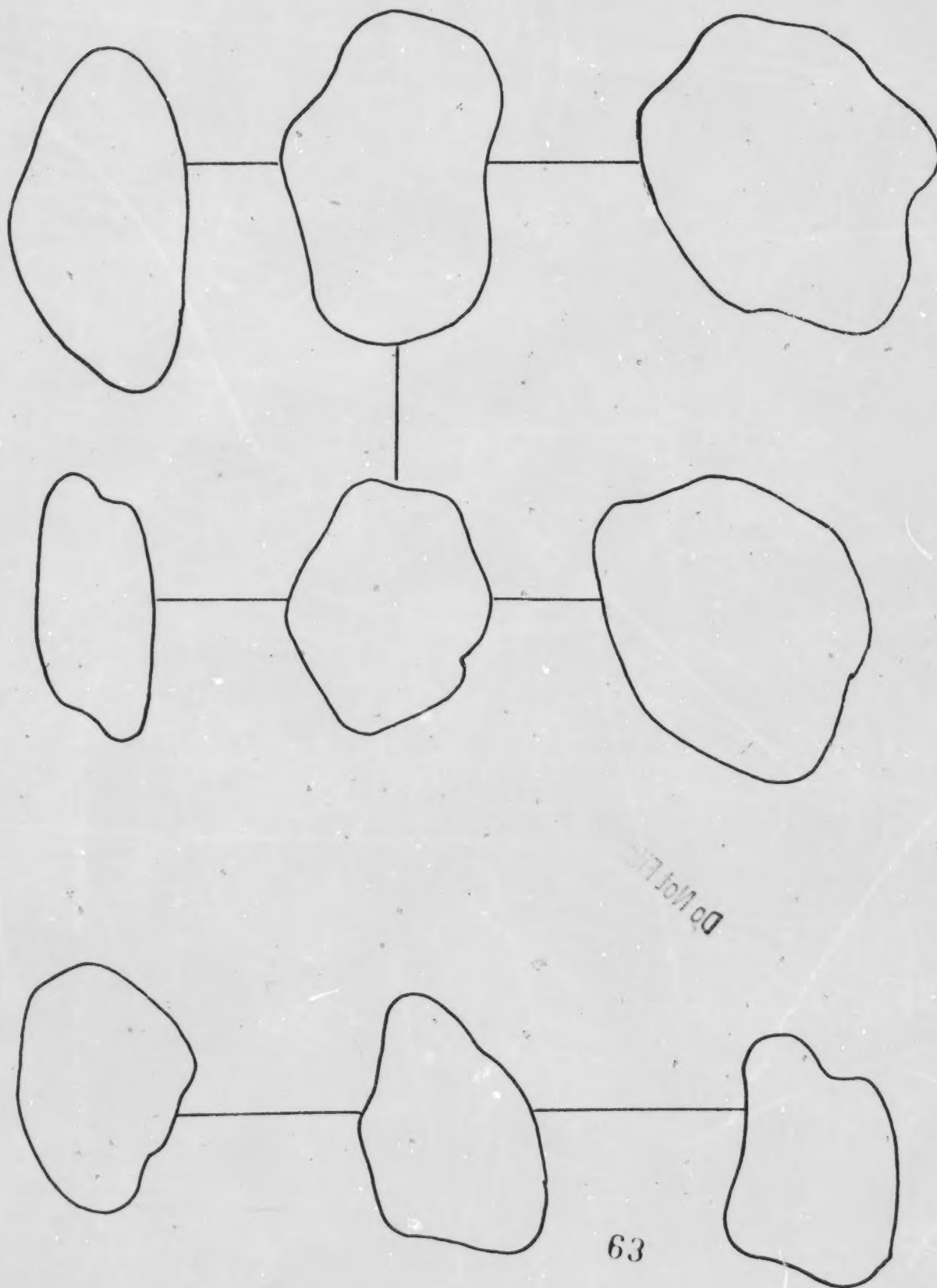


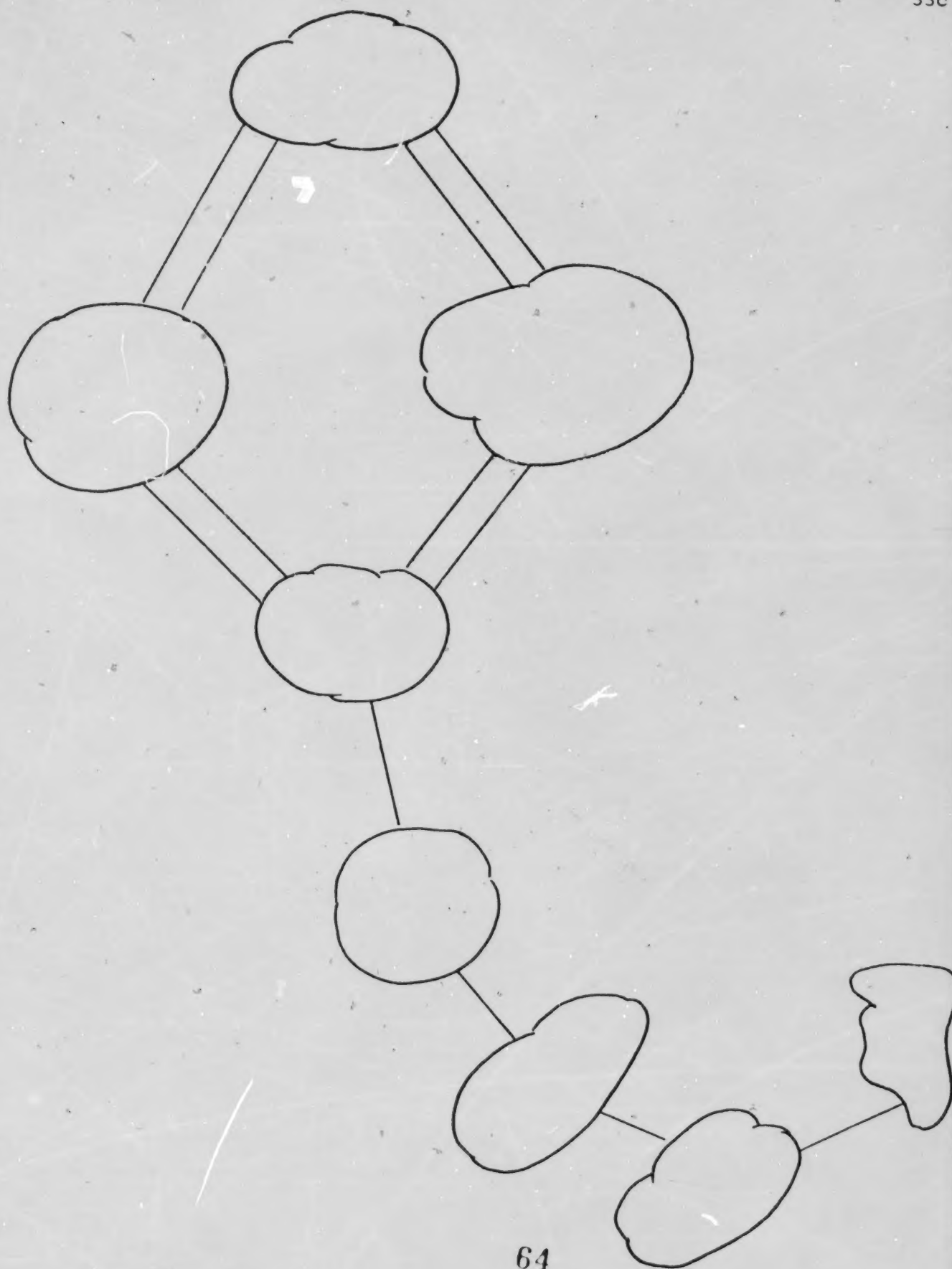


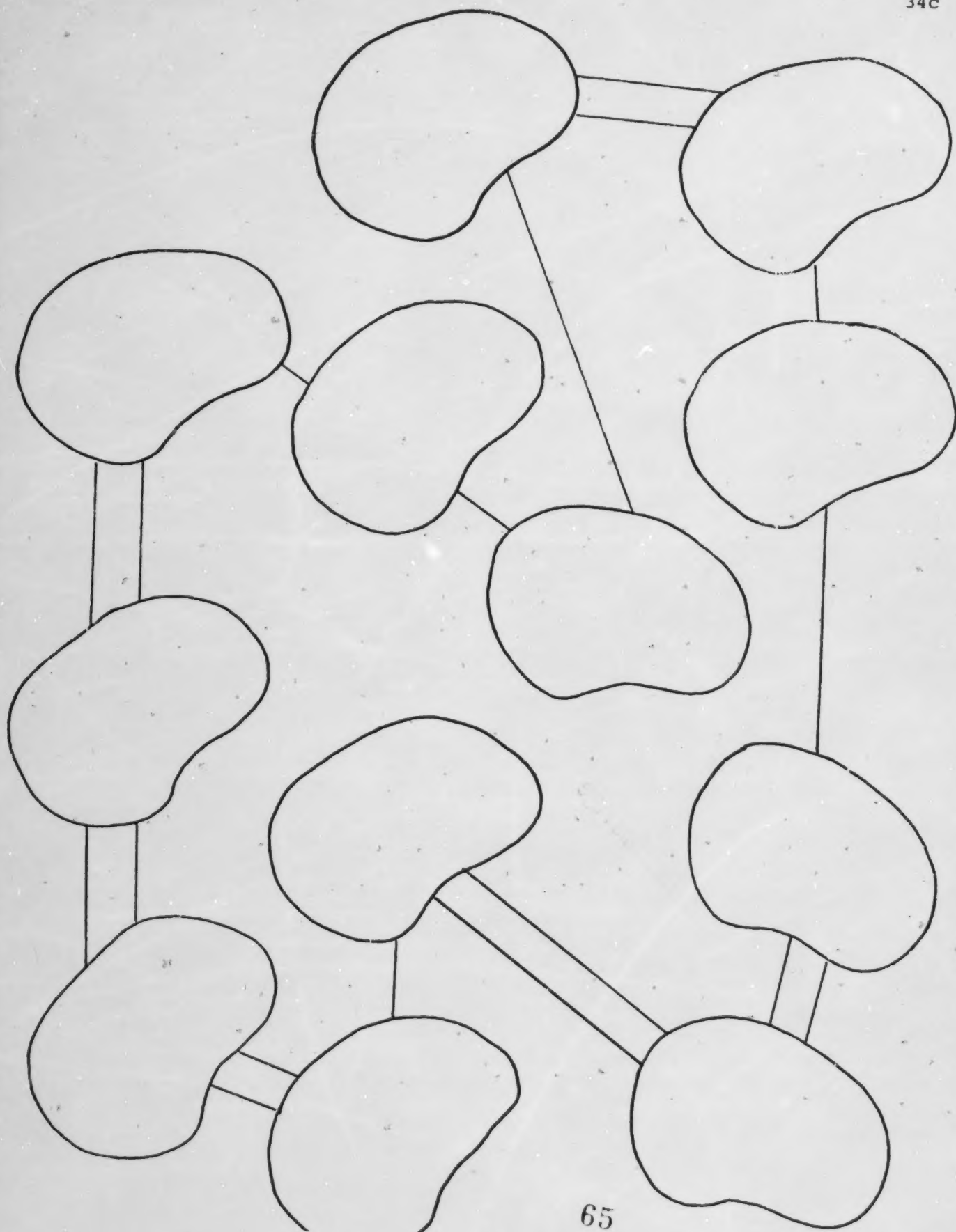


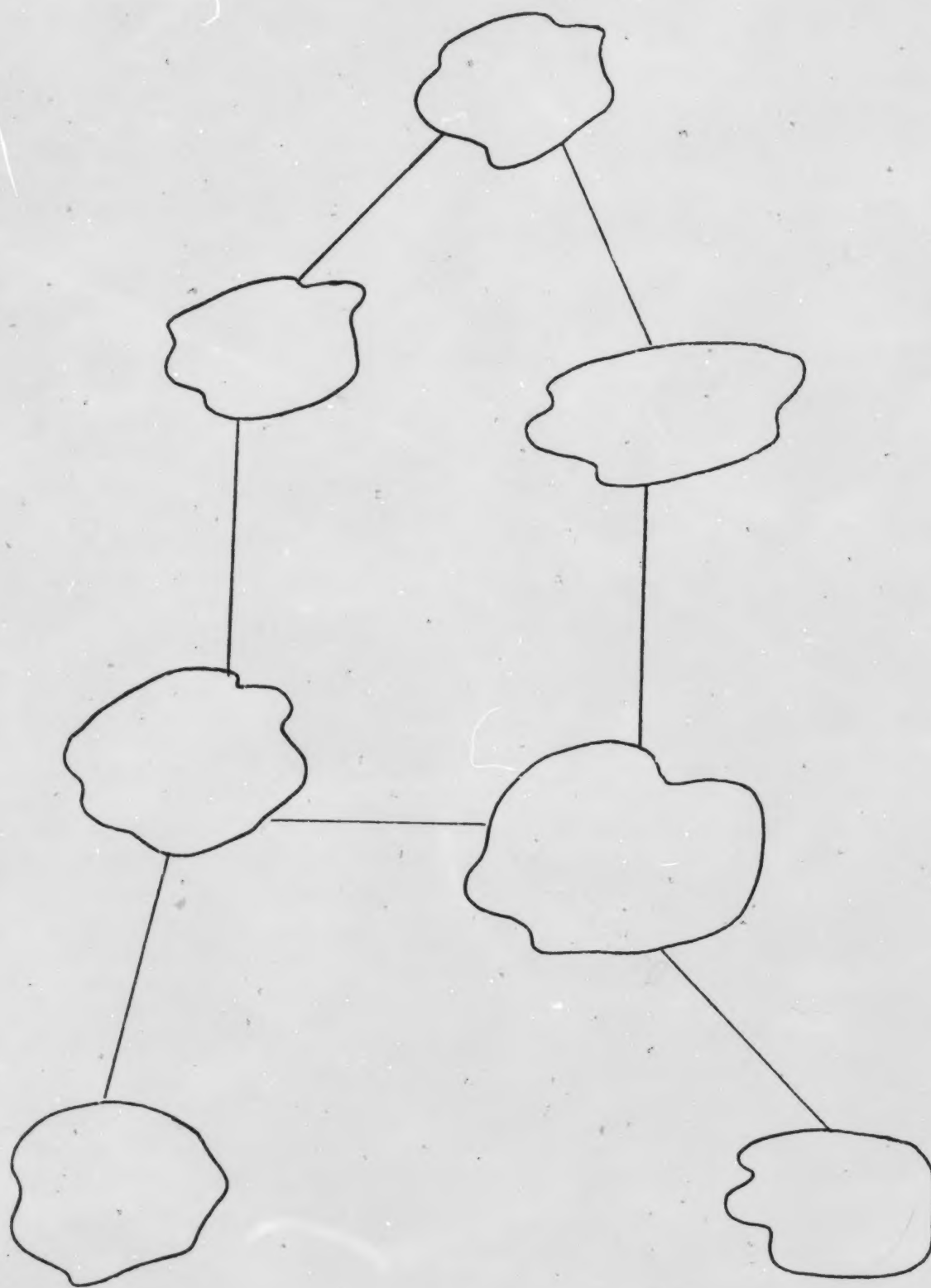


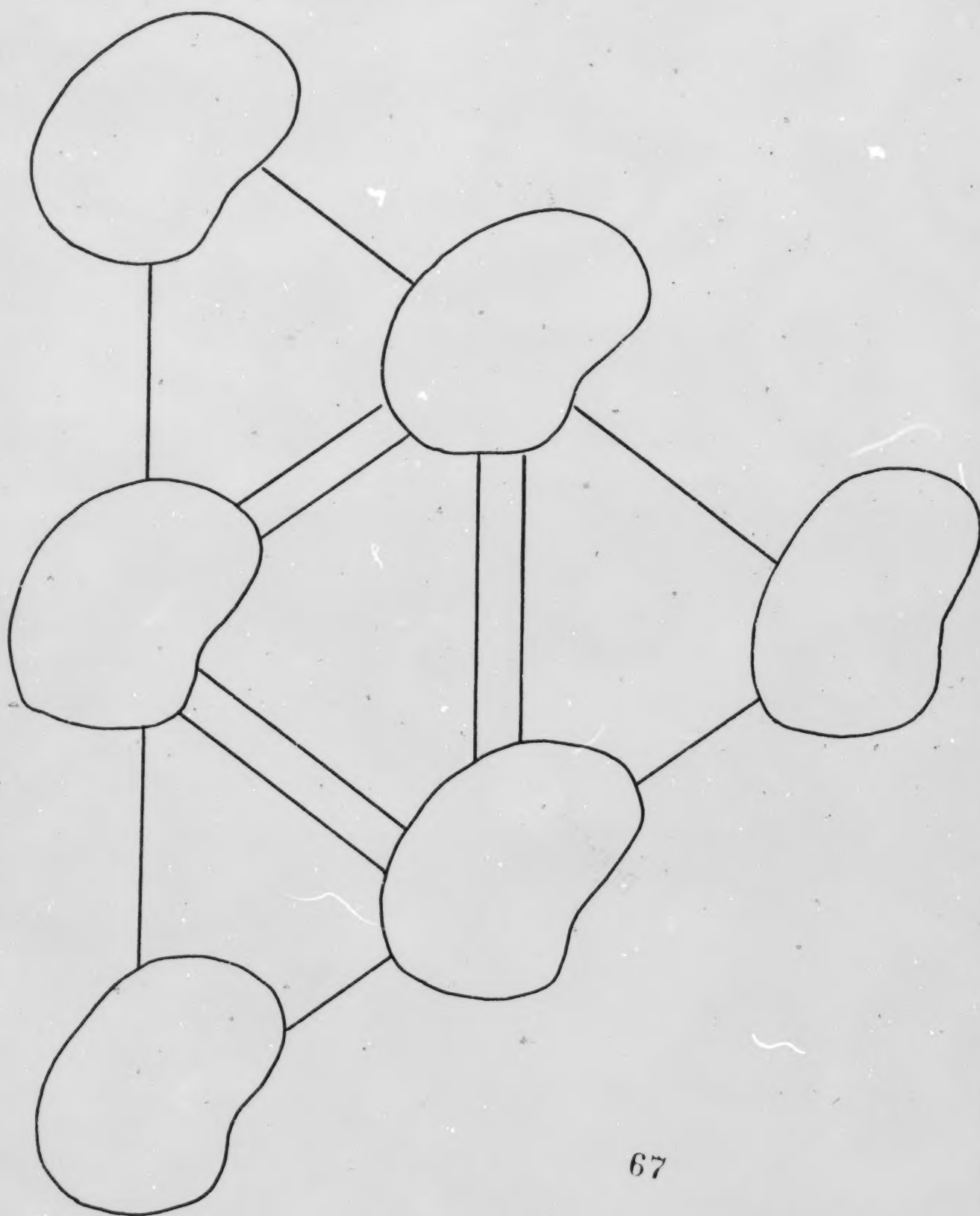


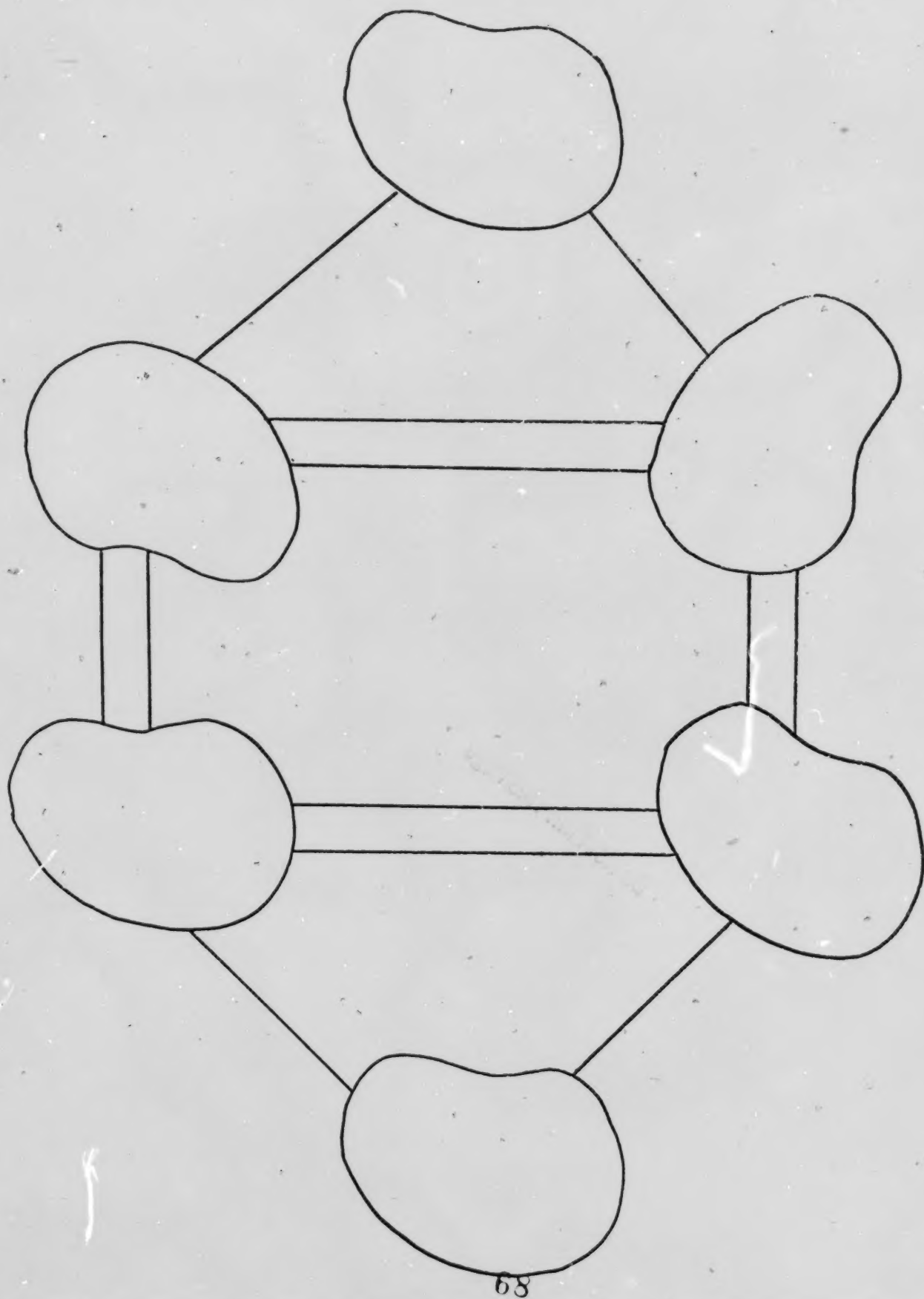


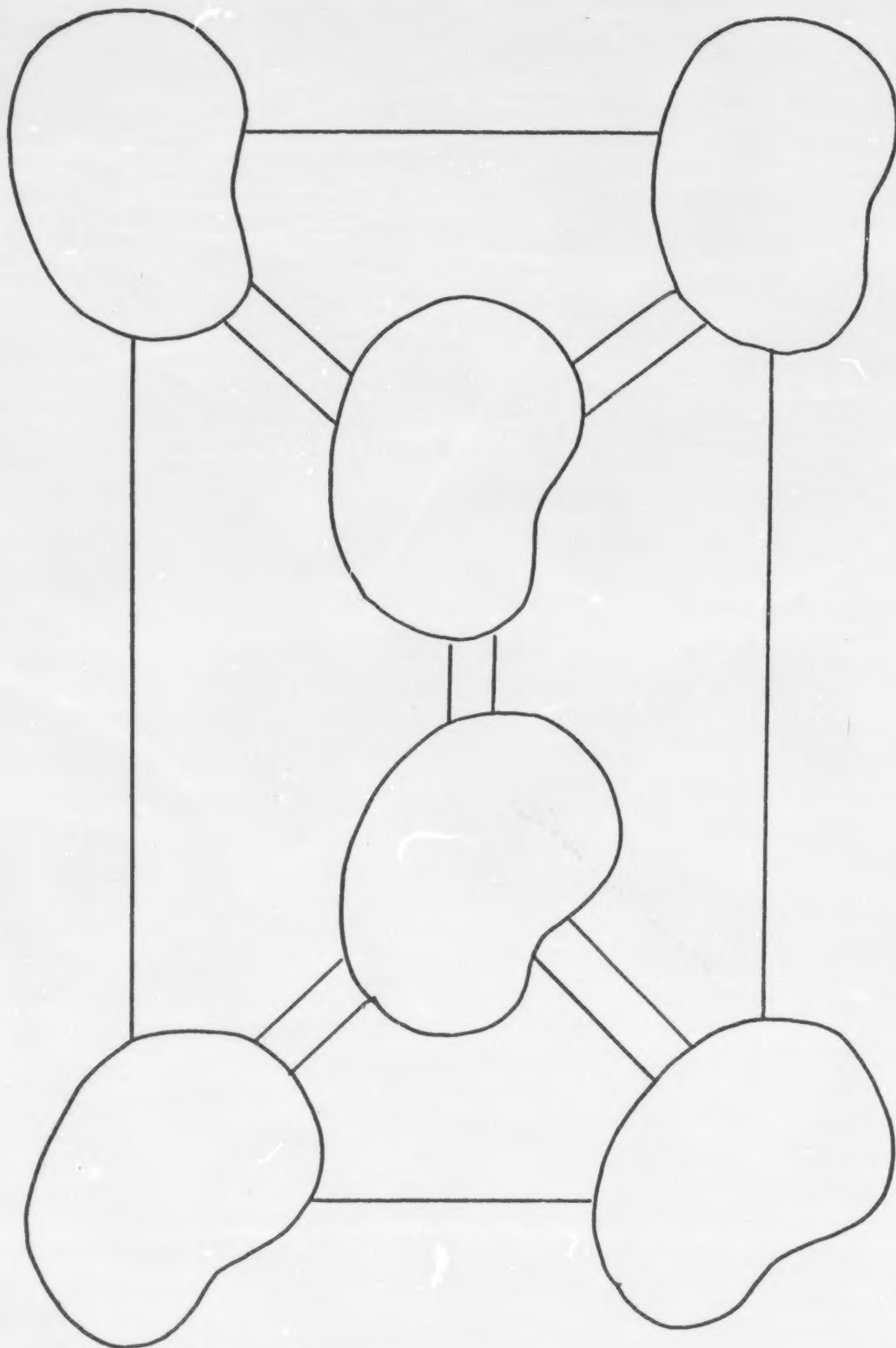


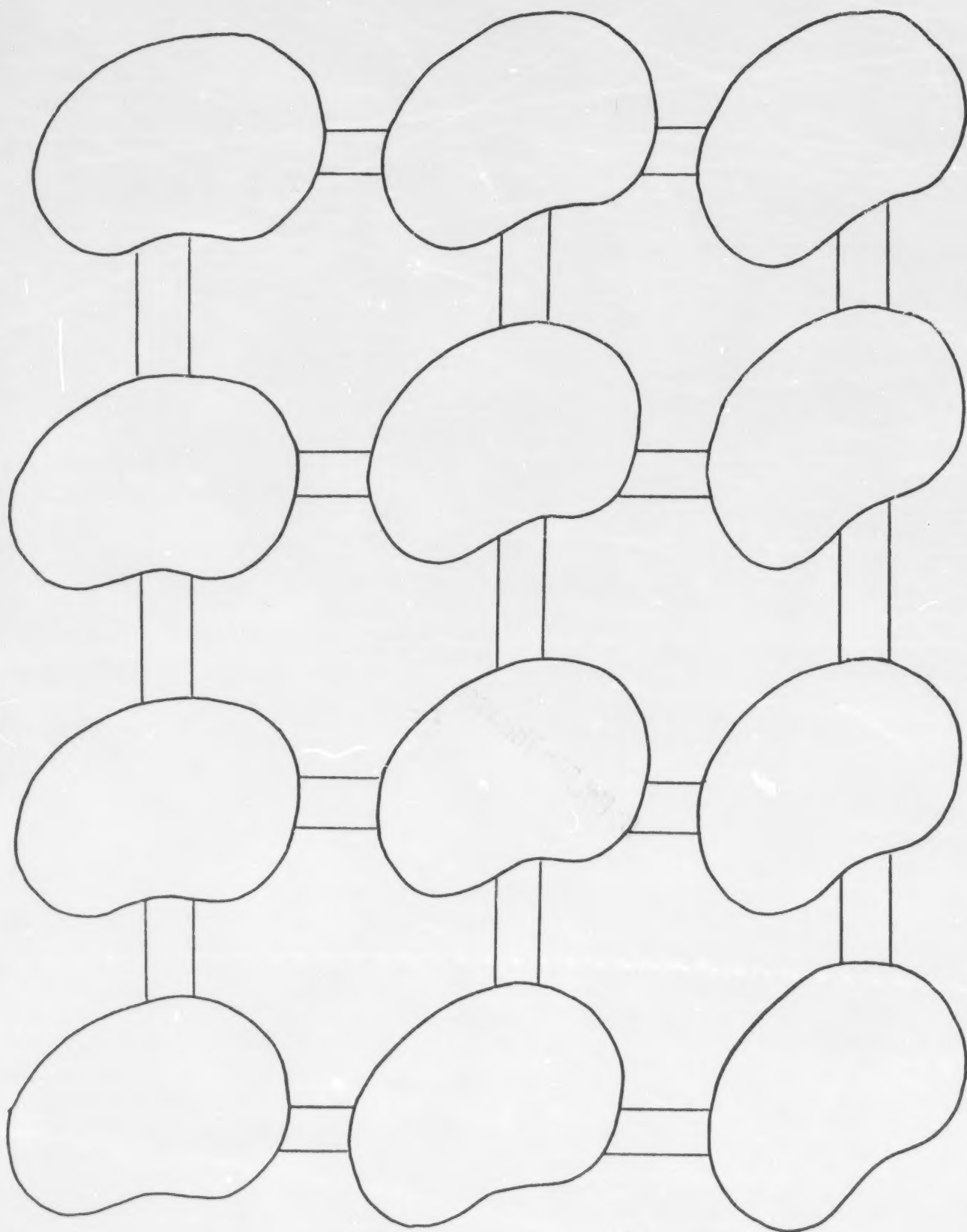










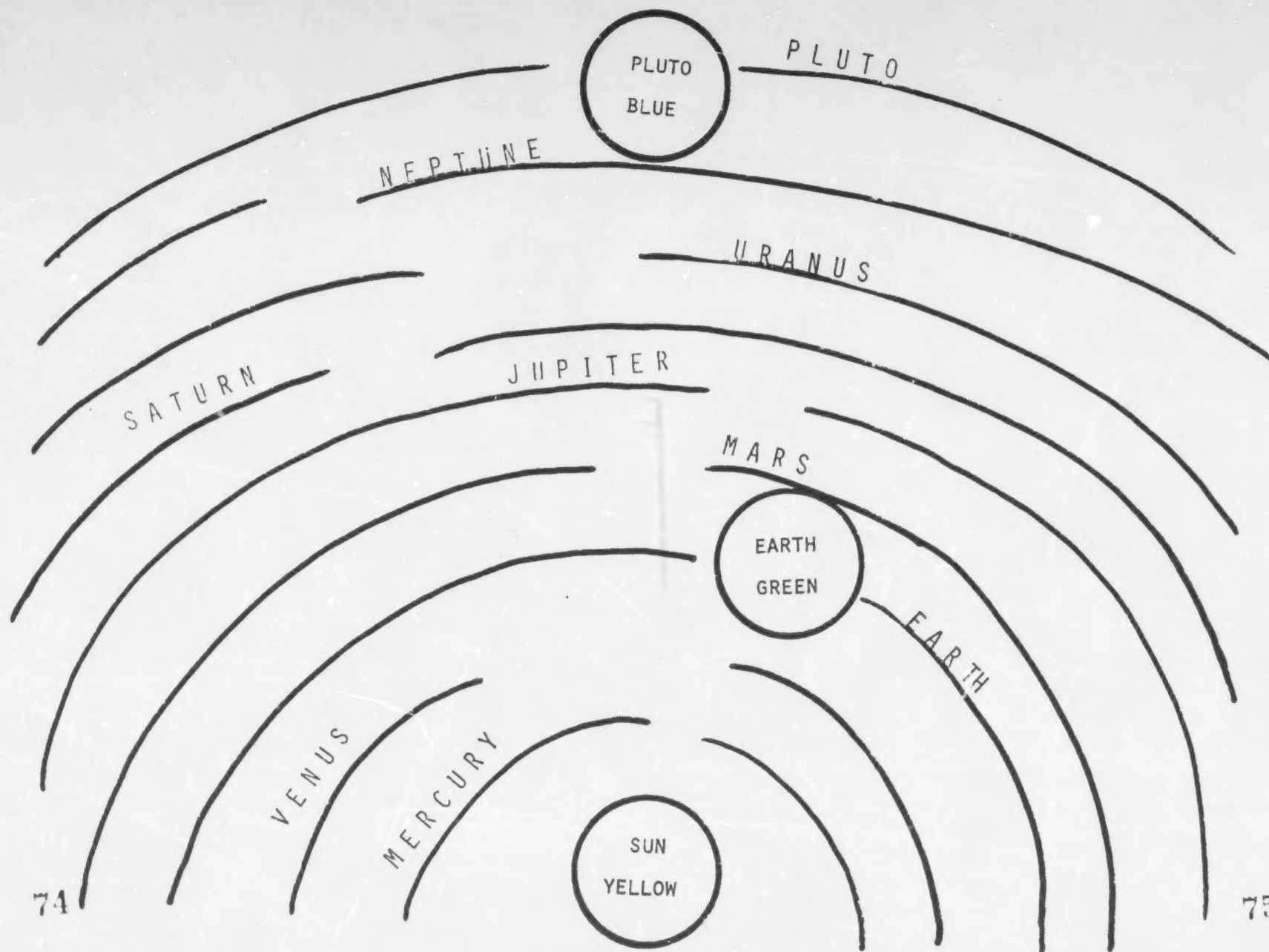




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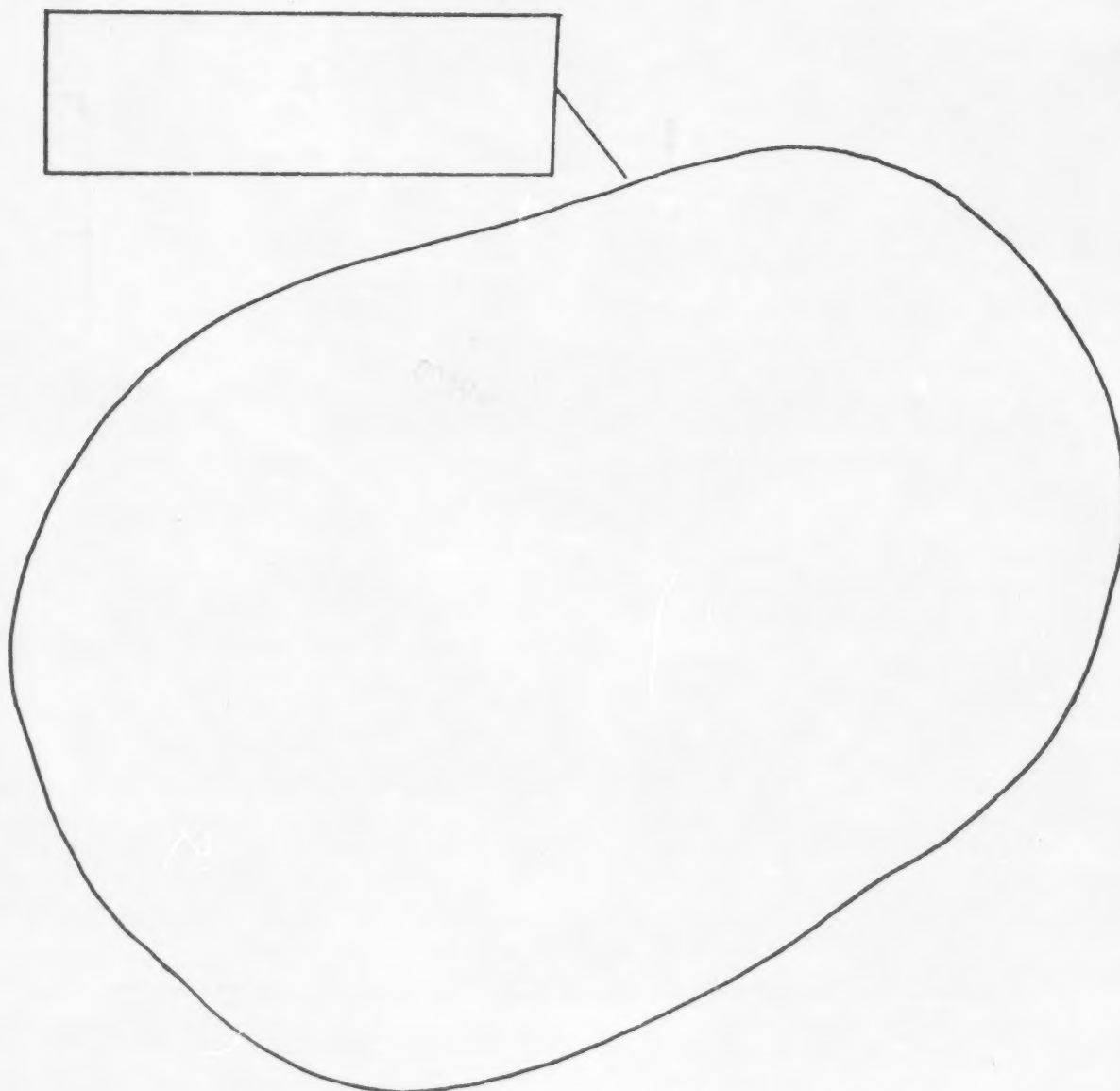
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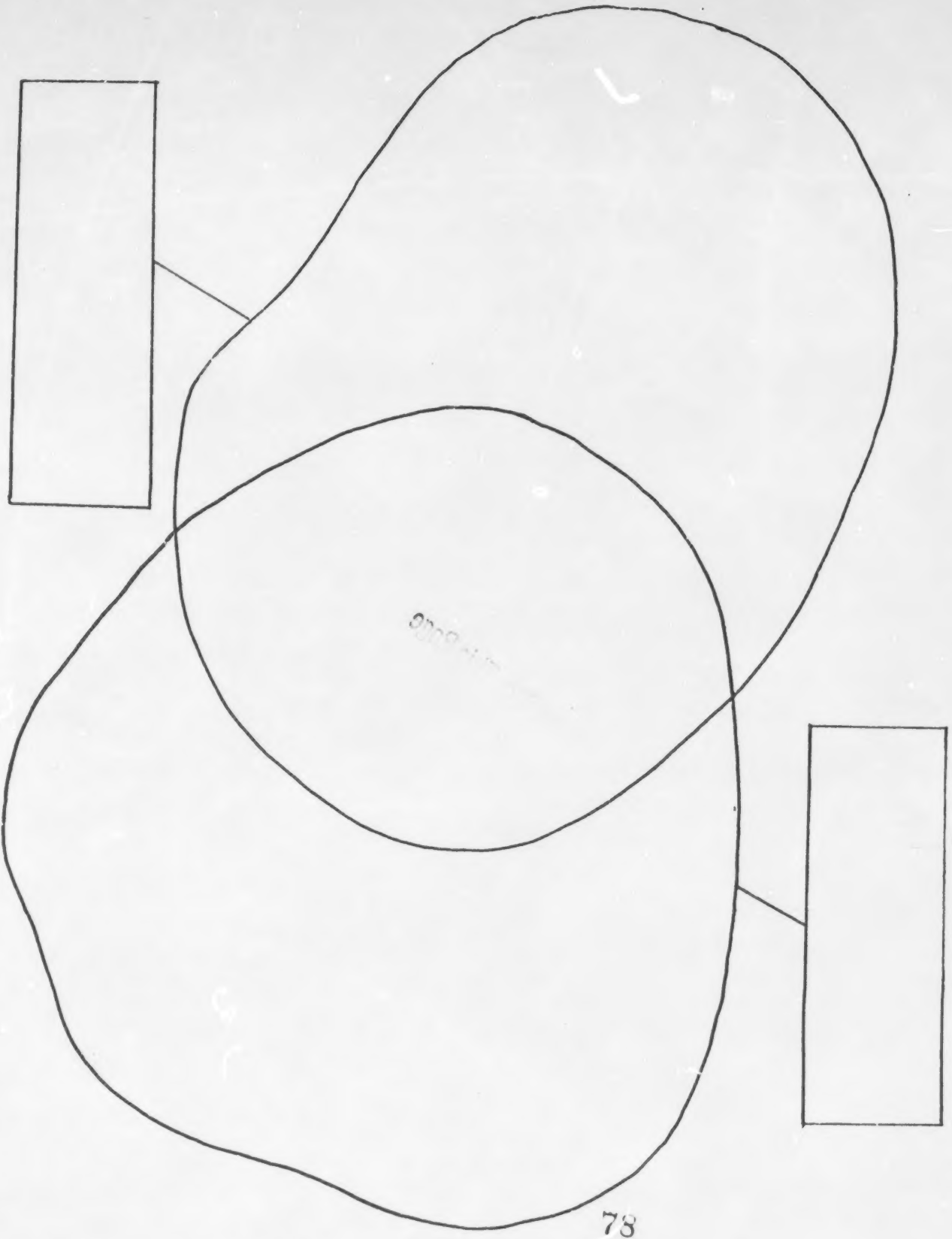


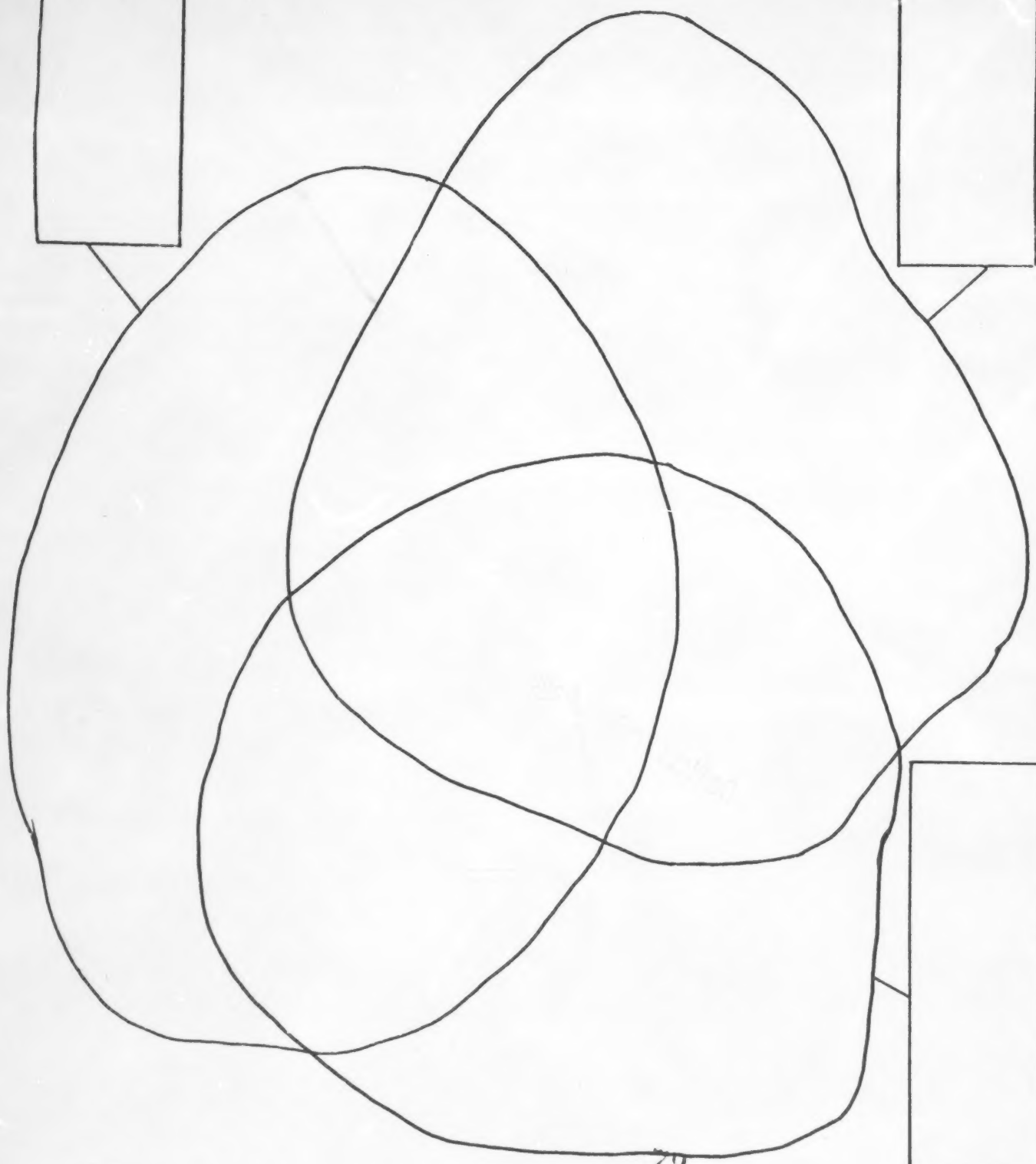
STRING GAME I

IDENTIFICATION CARDS II

LARGE	SMALL
TRIANGLE	SQUARE
CIRCLE	BLUE
GREEN	YELLOW
RED	NOT TRIANGLE
NOT SQUARE	NOT CIRCLE
NOT BLUE	NOT GREEN
NOT YELLOW	NOT RED







IDENTIFICATION CARDS III

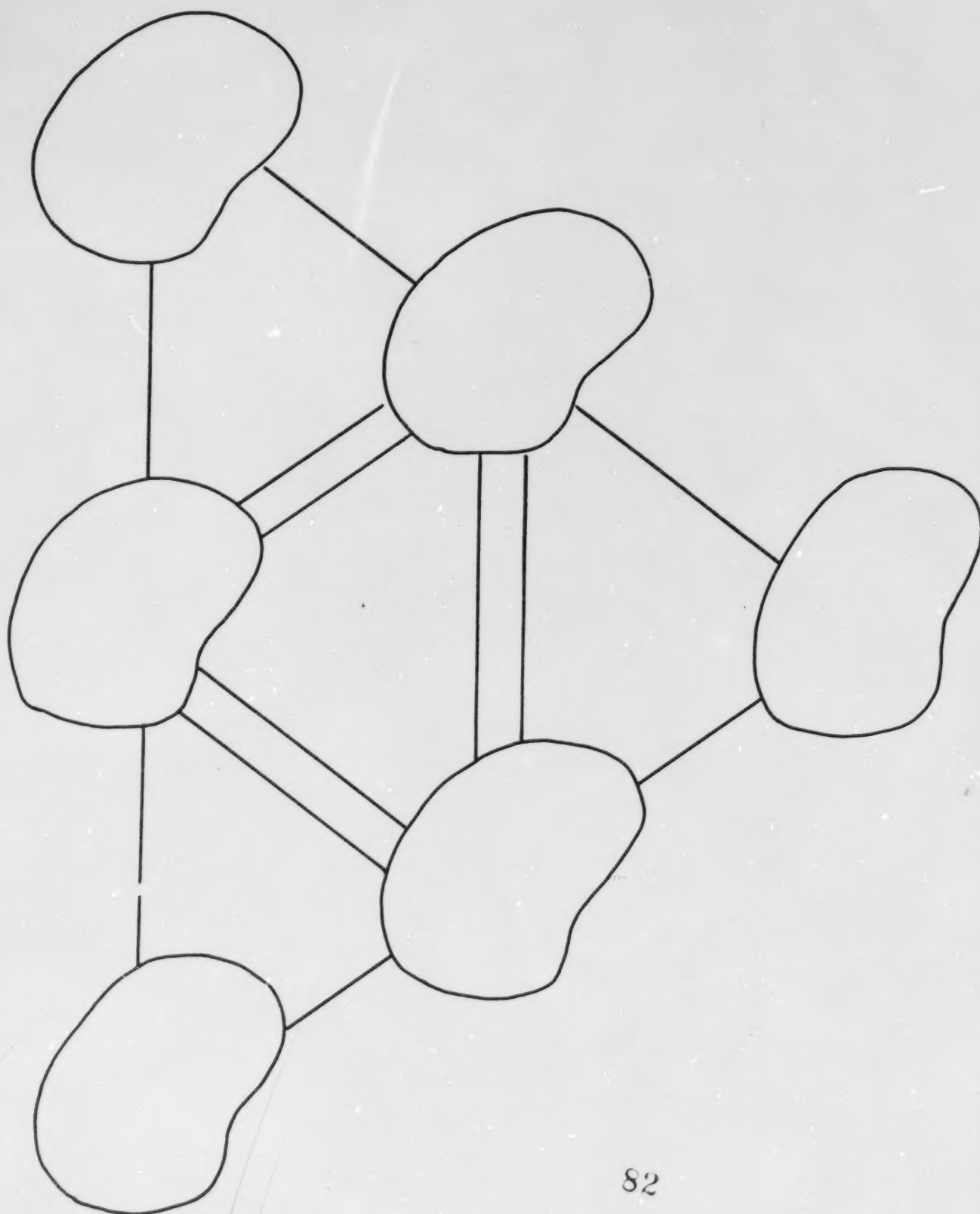
PRIME NUMBERS	EVEN NUMBERS
$\square > 6$	$\square < 20$
MULTIPLES OF 3	DIVISORS OF 24
$\square > 12$	MULTIPLES OF 5

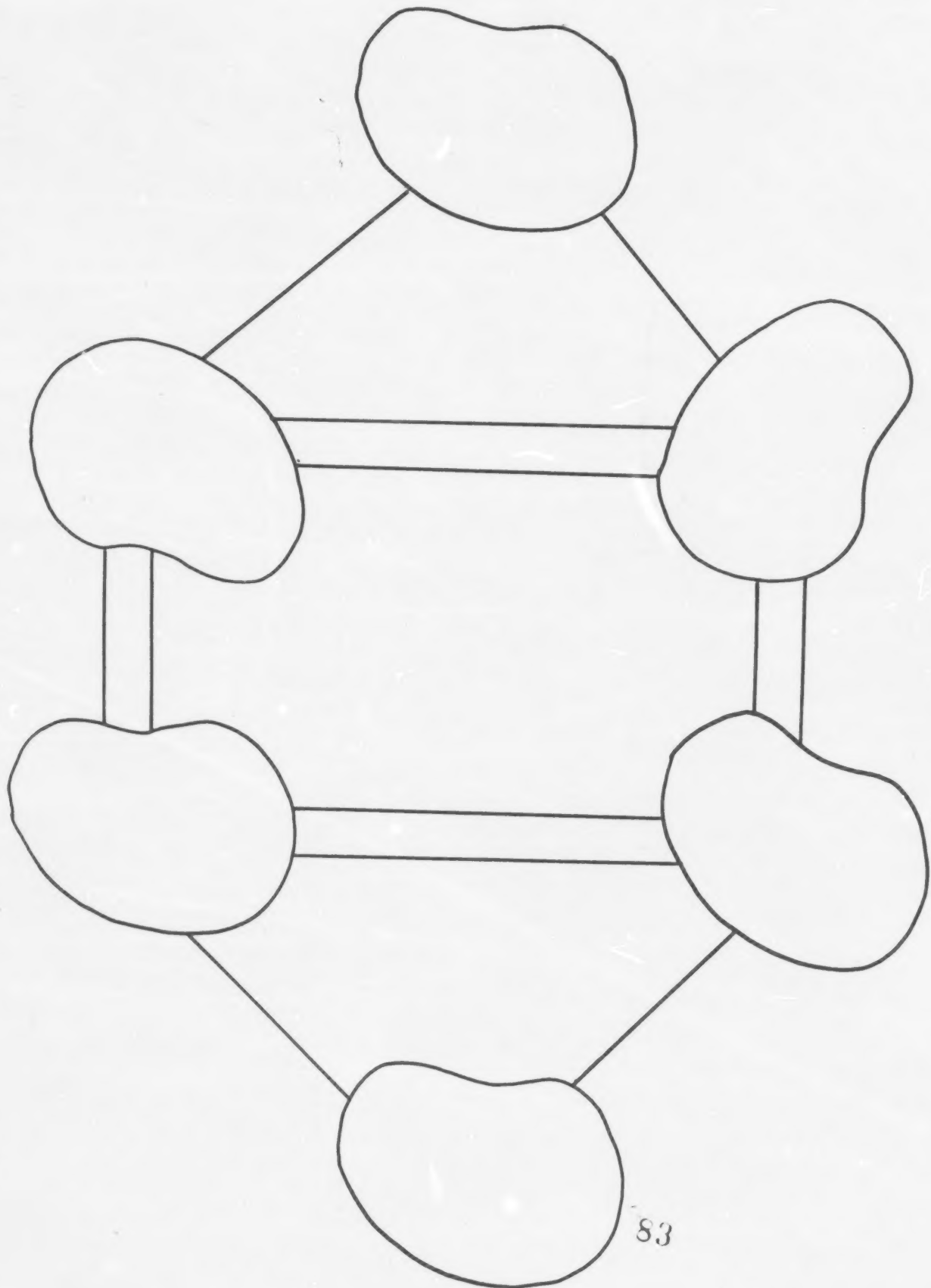
1	2	3	4	5	6
7	8	9	15	25	24
12	17	21	29	33	14
35	42	28	10	31	20

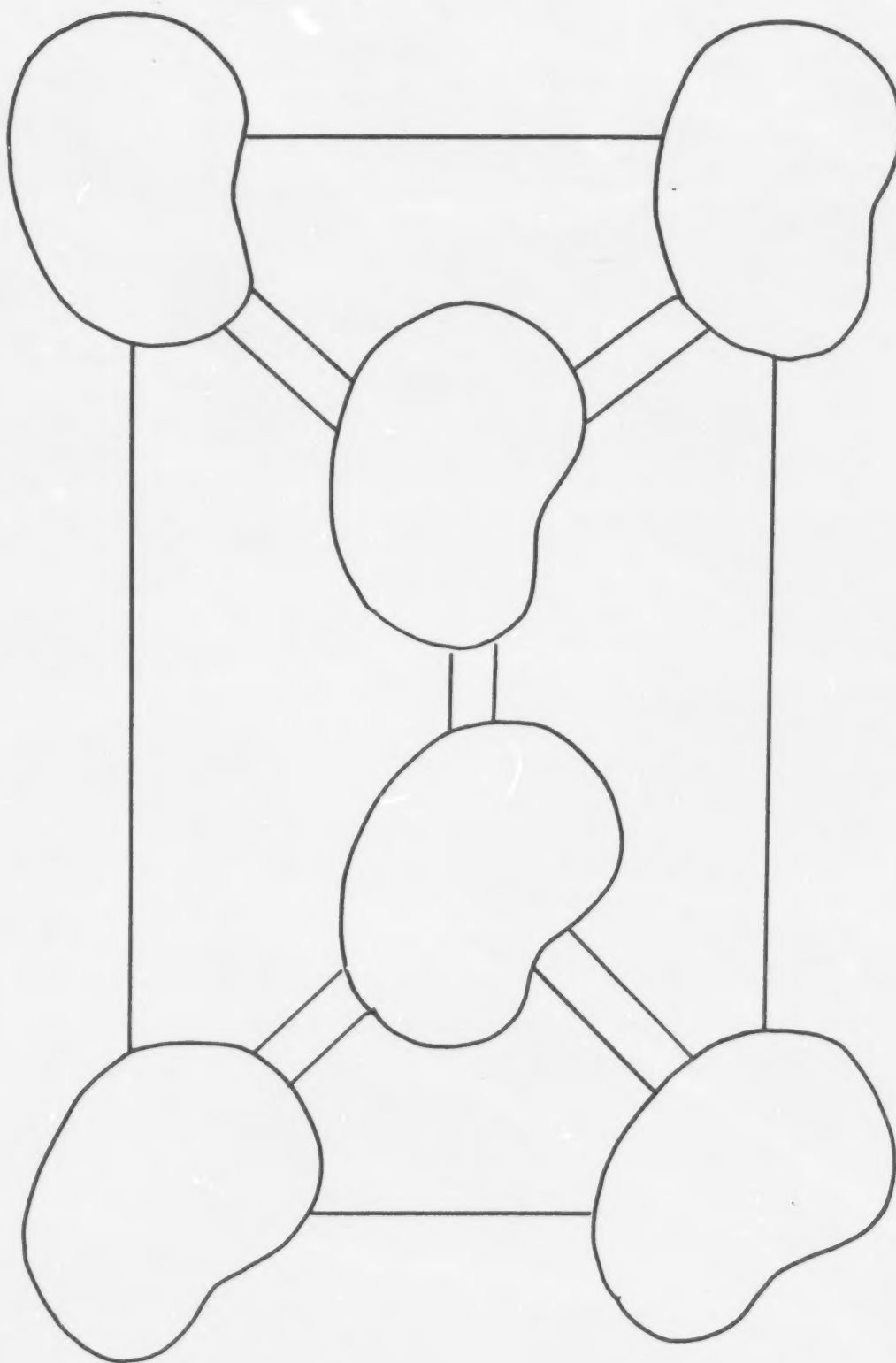
IDENTIFICATION CARDS III

MULTIPLES OF 2	☐ $>$ -10
MULTIPLES OF 3	☐ $>$ -50
MULTIPLES OF 4	☐ $<$ 10
MULTIPLES OF 5	☐ $<$ 50
MULTIPLES OF 10	

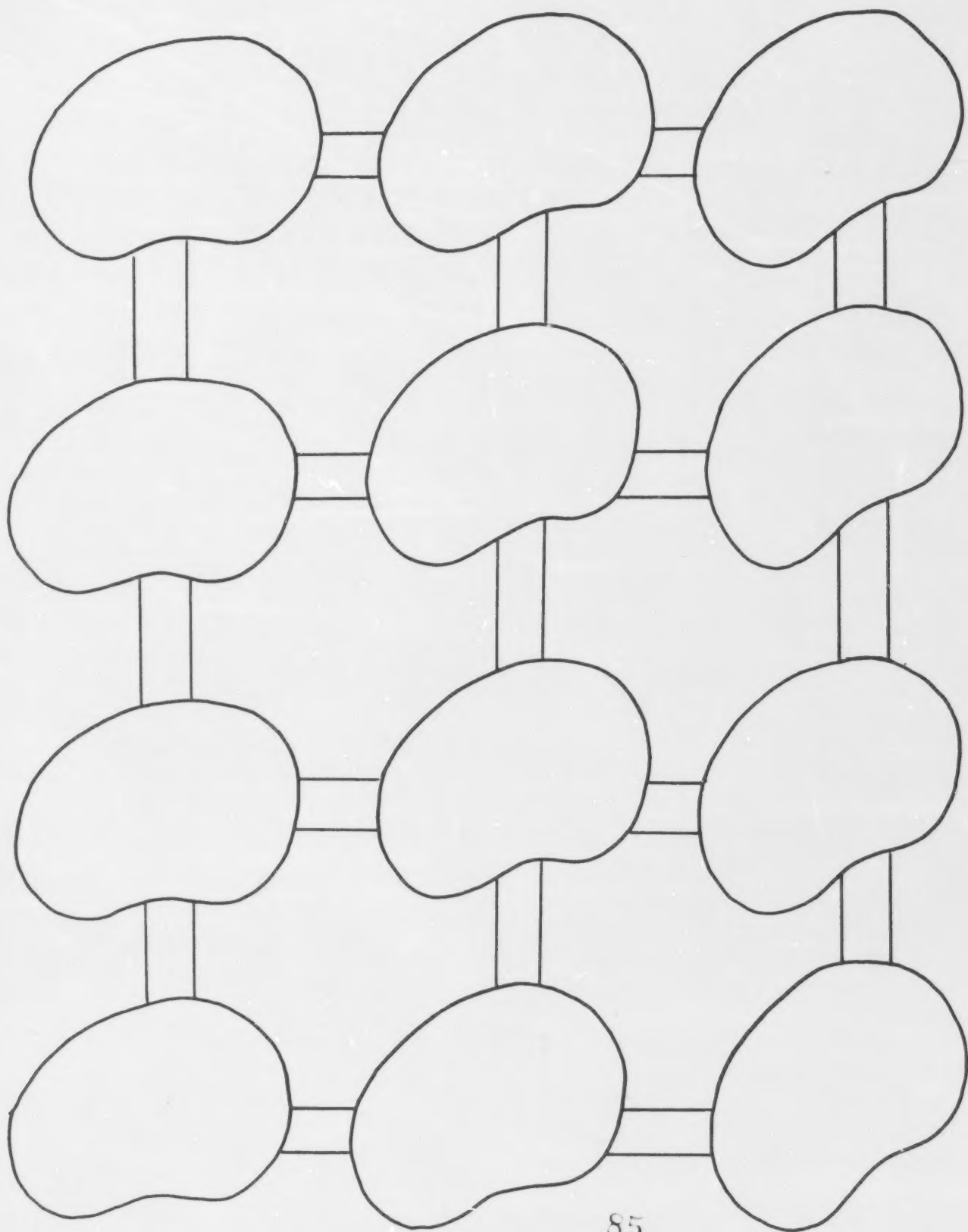
-100	-80	-55	-20	-15	-12
-5	-2	-1	-6	1	10
24	7	99	45	0	105
30	15	60	40	100	27







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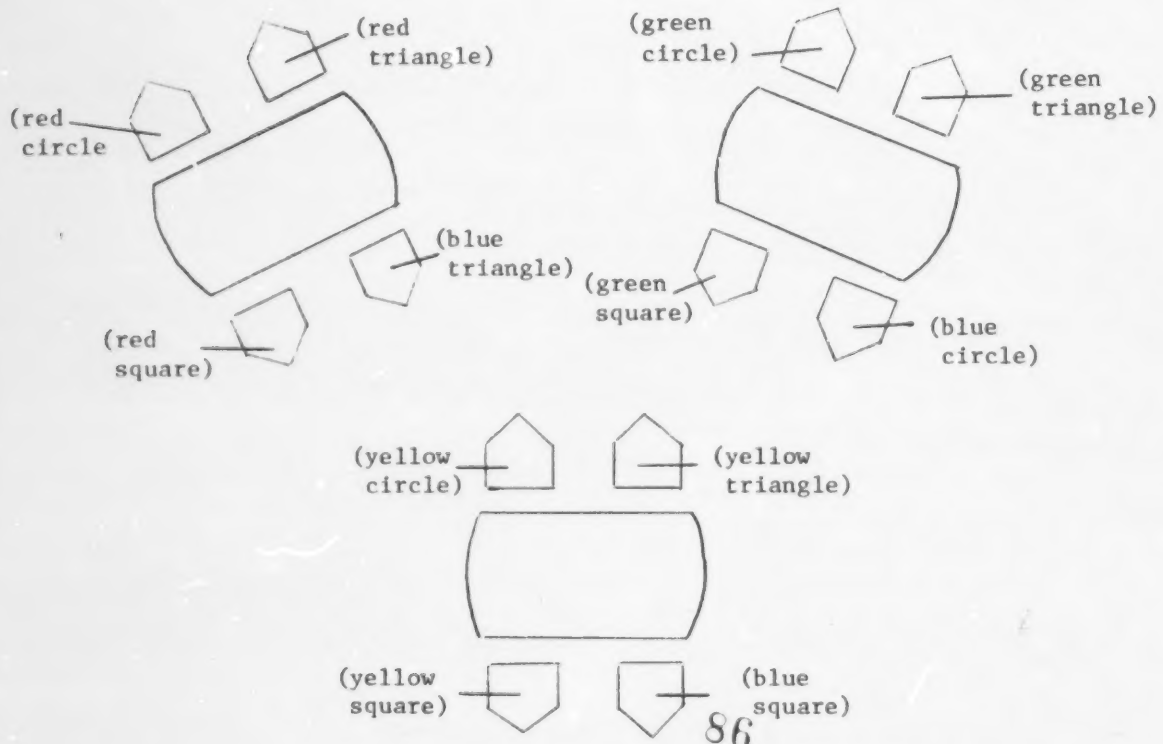
Meal Time

Purpose: To develop classification skills in a problem solving situation.

Materials: The small logic blocks.

Here is a logic puzzle that will make you think. Use only the small logic pieces. The small blocks are to be seated at the tables for their meal, but they have to be seated in a special way. No two blocks which are the same color can sit next to each other nor directly across from each other at more than one table.

For example, if a red block sits next to a green block at Table 1, then a red block can not sit next to nor directly across from a green block at Table 2 or Table 3. See if the logic blocks can be seated correctly.

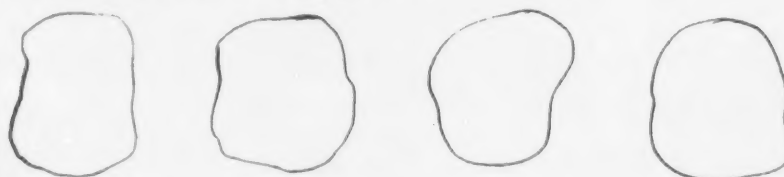


Variety Pack

Purpose: To develop logical classification and thinking skills.

Materials: Yarn, logic blocks and colored paper.

1. Pass out 4 pieces of yarn to each student. The yarn should be about 1 meter in length and tied into a loop. Each of the four pieces should be of a different color.
2. Pass out the logic blocks to each student. (It is not necessary to use all of these, especially at the beginning when the children are just becoming familiar with them.)
3. Make 4 separate regions with the yarn. Put the blocks in the regions so that the blocks in each region have the same size, color or shape.



4. How many different ways can you arrange the pieces according to color? shape? size?

* * * * *

1. Make a large chart of flower stems in rows (24). Instead of circles, squares, etc., use roses, tulips, petunias, etc., of various sizes and colors. Flower tops are made from construction paper.

- a) How does your garden grow? Have the students arrange the flowers in any way they wish.



- b) Arrange the flowers so that each is different in one way from the flower next to it. In 2 ways. In 3 ways.
- c) Make 3 rows so that each row contains like flowers that are different from the flowers in the other rows. How many ways can we do this?

2. Make a bouquet of flowers.



- a) Arrange the bouquet so that each flower is different in one way from the flower next to it; in two ways; in three ways.
- b) Arrange the bouquet so the flowers are all alike in one way, in two ways, in three ways.

Betcha Can't

Purpose: To classify objects on more than one dimension at a time (logical comparisons).

Materials: The large red, blue, and yellow blocks. The 3 X 3 grid on the next page.

Number of players: One

Problem 1. Place the 9 blocks so all the blocks in each row have the same color and all the blocks in each column have the same shape.

Problem 2. Place the 9 blocks so all the blocks in each row have the same color, but no two blocks in each column have the same shape.

Problem 3. Place all 9 blocks so no two blocks in the same row have the same color or shape and no two blocks in the same column have the same color or shape.

Problem 4. This is the same as problem 3, but in addition no two blocks in each of the two main diagonals can have the same color or shape. (This problem is impossible to do with this additional restriction.)

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Block Dominoes

Purpose: To develop strategies and thinking skills.

Materials: All 12 large attribute blocks. The grid sheet
on the next page.

Number of players: Two

All 12 blocks are made available to both players. The first player selects any block and places it in any one of the empty cells. The second player then places a block adjacent to the first block. If the block is placed vertically above or below the first block the two blocks must have exactly a two difference, since the two blocks would be separated by a double line. If the block is placed horizontally to the left or right of the first block, it must have exactly a one difference as indicated by the single line. The players alternate turns placing one block at a time until no moves are possible. The player placing the last block wins the game.

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← HORIZONTAL →

92

Logic Rummy

Purpose: To develop logical comparison.

Materials: 24 or 48 3x5 cards.

Have a deck of 3" x 5" cards. In the deck of cards, each card represents one of the logic blocks. That is, each card has an actual color picture of one of the blocks.

Two children play together. Each gets five cards and the rest of the deck is placed face down. They take turns picking a card from the deck. If the card they pick does not help them, they must discard it. If one chooses to keep the card, another must be discarded. The other player has the option of picking it up. Have the cards that are discarded placed face up in a row. If a student sees a set in the discards that fits the requirements of the game, he/she may pick up all the discarded cards, put the set of three aside, and discard one card.

On the beginning level the child will make sets of three cards picturing objects alike in at least one way. When the child has three cards that meet the requirements of the game, he/she puts them aside. The winner is the one with the most three-card sets when the deck has been exhausted.

As the students progress, the requirements on the three cards within the set can be changed to be alike in exactly two ways.

Lost Planets

Purpose: To develop beginning logical relationships and introduce our solar system.

Diagram on next page.

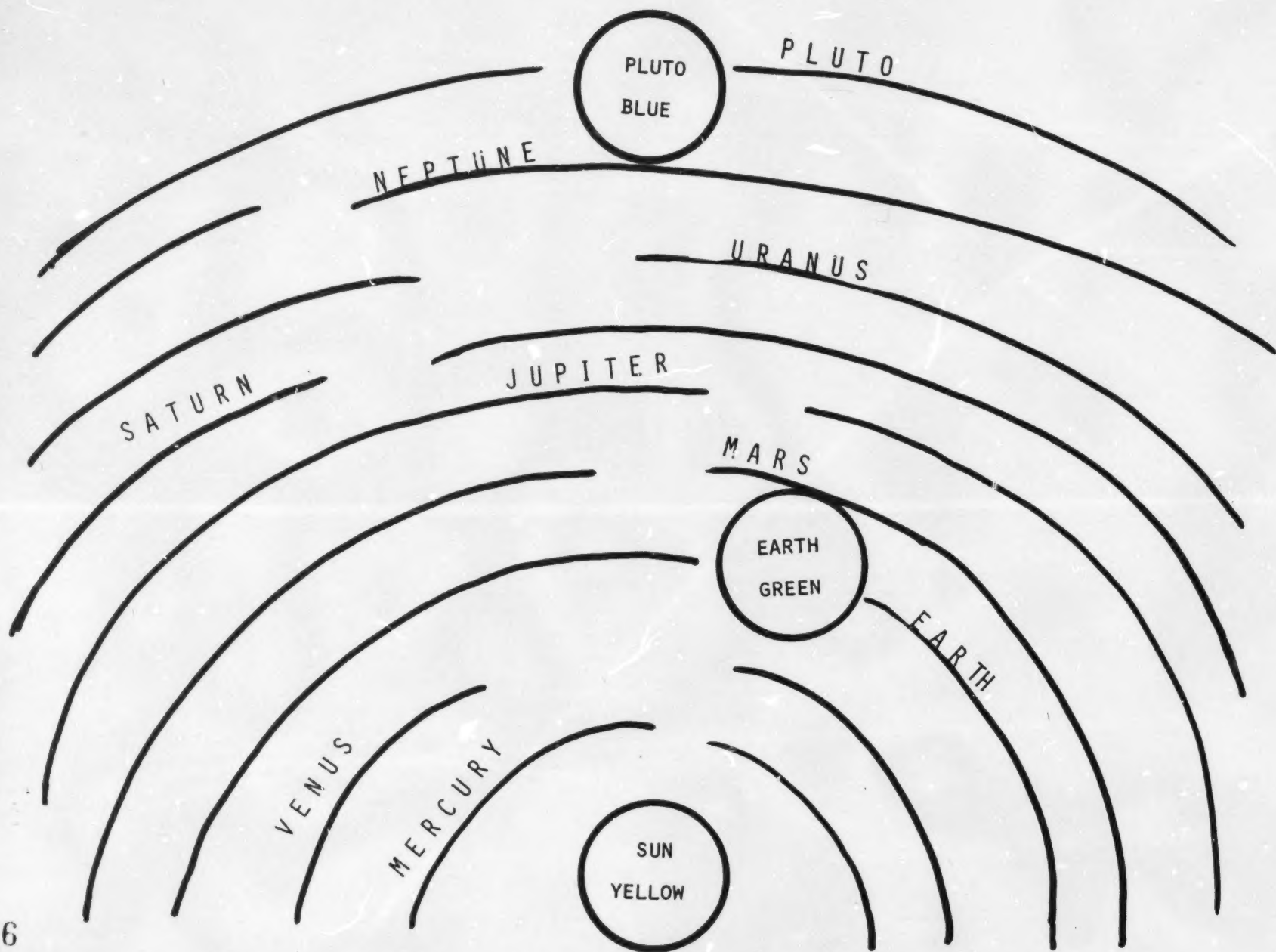
Materials: 1 large blue circle 1 small blue triangle
 1 large red circle 1 small yellow circle
 1 large green circle 1 small green square
 1 large green triangle

This is our solar system. Let's pretend that these shapes are planets. Place them in orbit according to the following rules:

1. The Sun is already in orbit (large yellow circle).
2. Can you make Mercury different from the Sun in one way?
3. Can you make Venus different from Mercury in two ways?
4. Earth has already been placed in orbit (small green circle).
5. Can you make Mars different from Venus in two ways?
6. Can you make Jupiter different from Mars in three ways?
7. Can you make Saturn different from Jupiter in two ways?
8. Can you make Uranus different from Saturn in two ways?
9. Can you make Neptune different from Uranus in one way?
10. Pluto is already placed in orbit (small blue circle).

One Answer

Mercury - small yellow circle
Venus - small blue triangle
Mars - large blue circle
Jupiter - small green square
Saturn - large green triangle
Uranus - large red circle
Neptune - large green circle



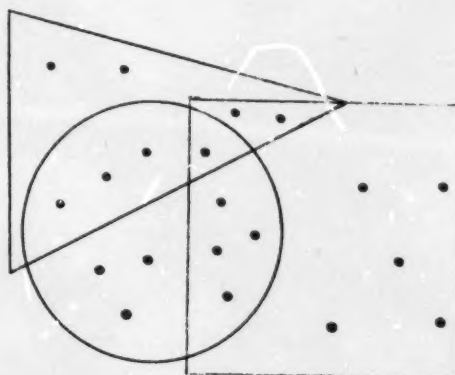
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Count Me

Purpose: To provide basic counting activities and work with logical connectives.

Materials: Chalkboard or handouts.

The children should count and record the number of dots that are requested in the following questions. The use of the words and, or, not, should be introduced or reviewed.



1. How many dots are in the triangle? (8)
2. How many dots are in the circle? (11)
3. How many dots are in the square? (12)
4. How many dots are in the square and not in the triangle? (9)
5. How many dots are in the circle and not in the square? (6)
6. How many dots are in the triangle and not in the square? (5)
7. How many dots are in the circle and in the square? (5)
8. How many dots are in the triangle and square? (3)
9. How many dots are in the circle and triangle? (4)
10. How many dots are not in the square and not in the circle? (2)

11. How many dots are not in the circle and not in the triangle? (5)
12. How many dots are not in the triangle and not in the square? (3)
13. How many dots are in the square or in the circle? (15)
14. How many dots are in the circle or in the triangle? (15)
15. How many dots are in the triangle or in the square? (17)
16. How many dots are in the square or circle or triangle? (20)
17. How many dots are in the triangle or square, and not in the circle? (9)

Ronald MacDonald

Purpose: To provide practice with logical connectives in a social setting.

Materials: Chalkboard or handouts

One day Miss Watsonheimer took her 5th grade children to MacDonalds for lunch. All those that bought hamburgers are shown by dots in the hamburger. All those who bought a malt are in the malt shape and all those that bought french fries are in the french fry shape.



1. How many children had fries? (8)
2. How many had fries and not hamburgers? (3)
3. How many children had a malt and a hamburger? (7)
4. How many had a hamburger and fries? (5)
5. How many had a hamburger, fries and a malt? (3)
6. How many had just one item to eat? (6)
7. How many children went for lunch? (16)
8. How many children had fries or a malt? (13)
9. How many children did have fries and did not have malts? (4)

10. How many children did not have a hamburger and did not have fries? (1)
11. How many children had at least two different items to eat? (10)
12. How many children had exactly two different items to eat? (7)
13. How many children had at most two different items to eat? (13)

Where Am I?

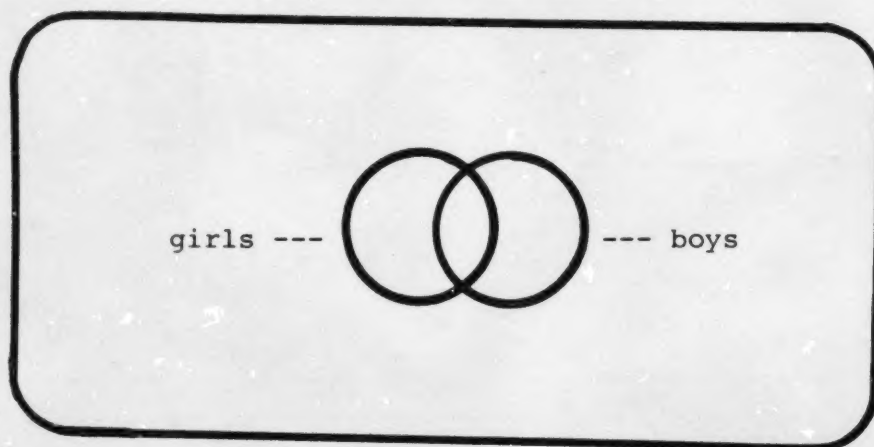
Purpose: To develop logical relationships in a social setting.

Materials: A chalkboard and 3 pieces of colored chalk.

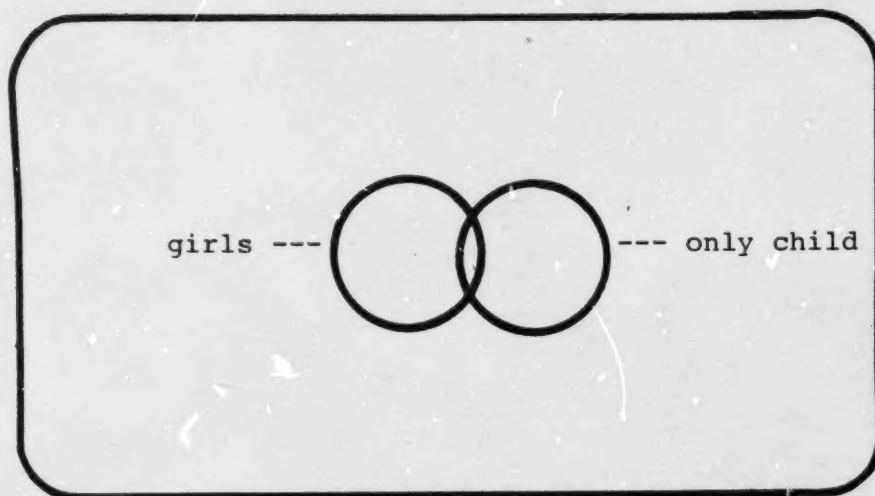
Number of players: The entire class.

Draw one of the following string diagrams on the board using a different color for each region. Have each student decide in which subregion they belong and then let them come to the board and put a dot in that region. When all the children are back in their seats ask various questions about the diagram. Place a dot in those subregions that are empty and ask if it is possible for a person to be in that subregion. If it is not possible, hatch mark it out. The activities are arranged from easiest to hardest, and the preceeding directions apply to each activity.

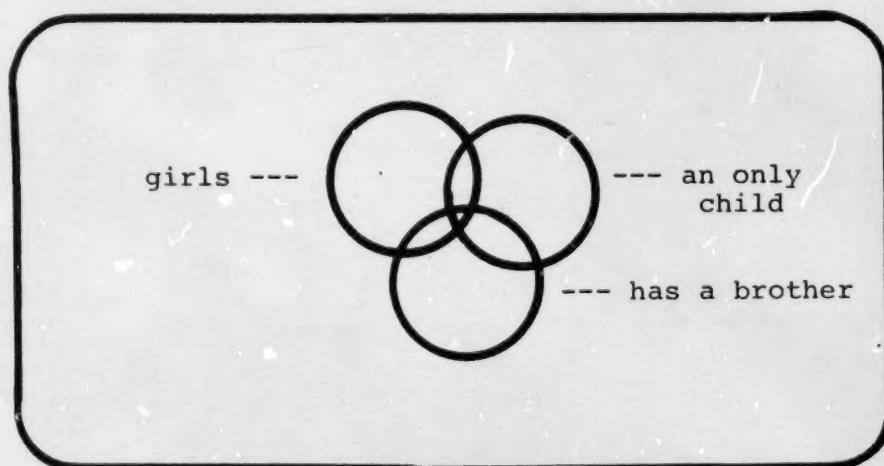
Activity 1



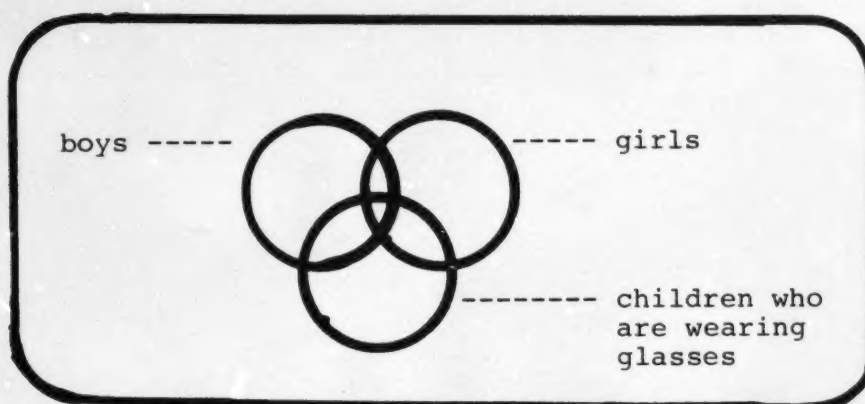
Activity 2



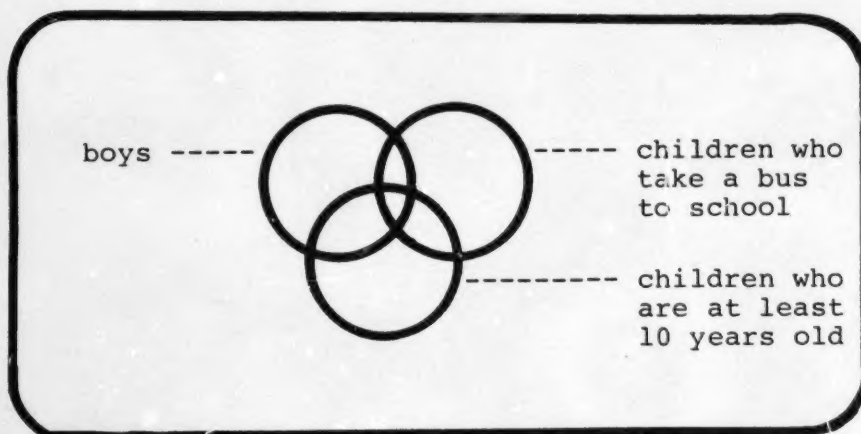
Activity 3



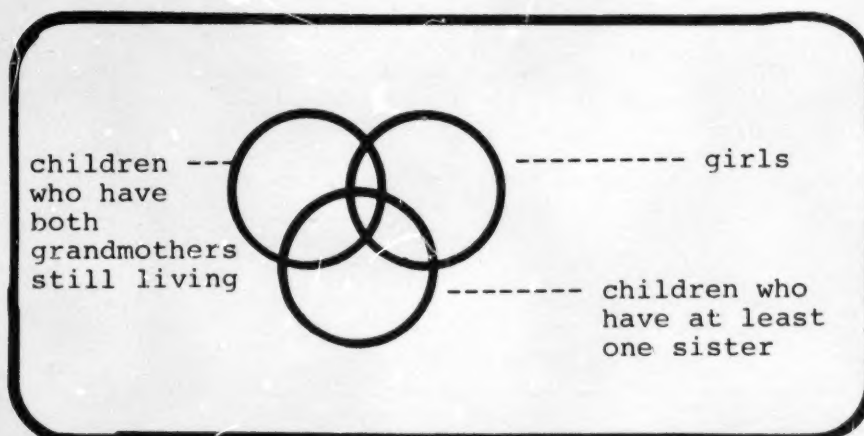
Activity 4



Activity 5



Activity 6



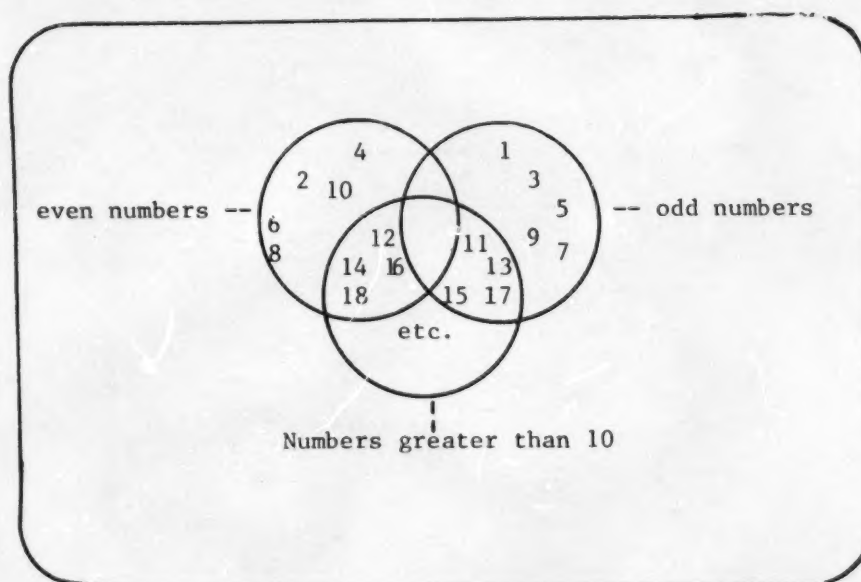
Who's Odd?

Purpose: To develop logical relationships in a numerical setting.

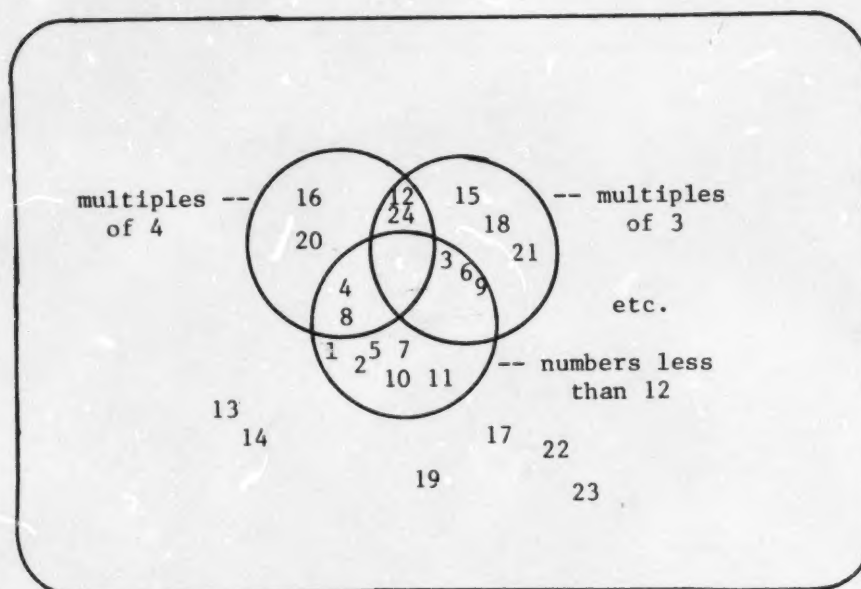
Materials: Chalkboard and colored chalk.

Number of players: The entire class

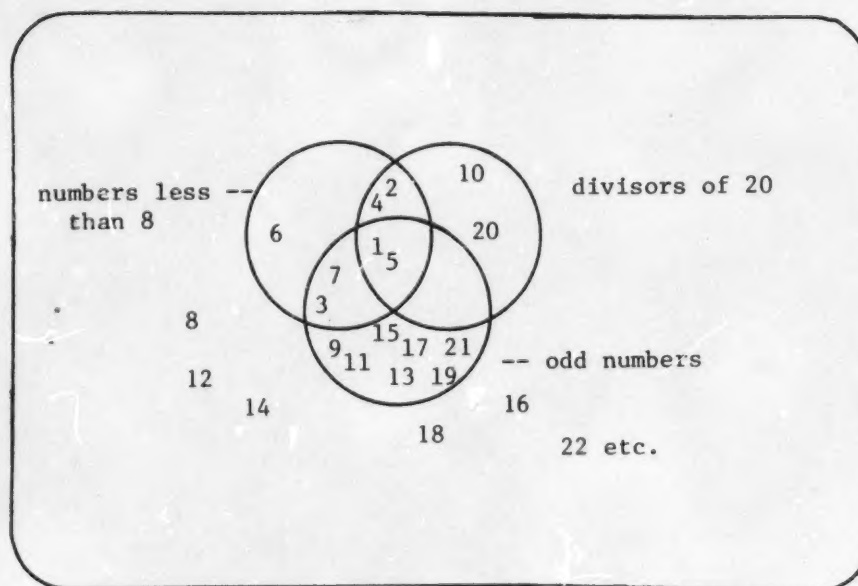
Place the following diagram on the board using a different color for each region. Then have the children stand in a line and write the number that represents their position in line in the appropriate subregion of the string diagram, i.e. the first student writes the number one, the second students the number two, etc. Discuss the diagram after all the students are back in their seats. Remember numbers can be placed in the region that is outside of all three regions. Again ask questions similar to those in Where Am I?



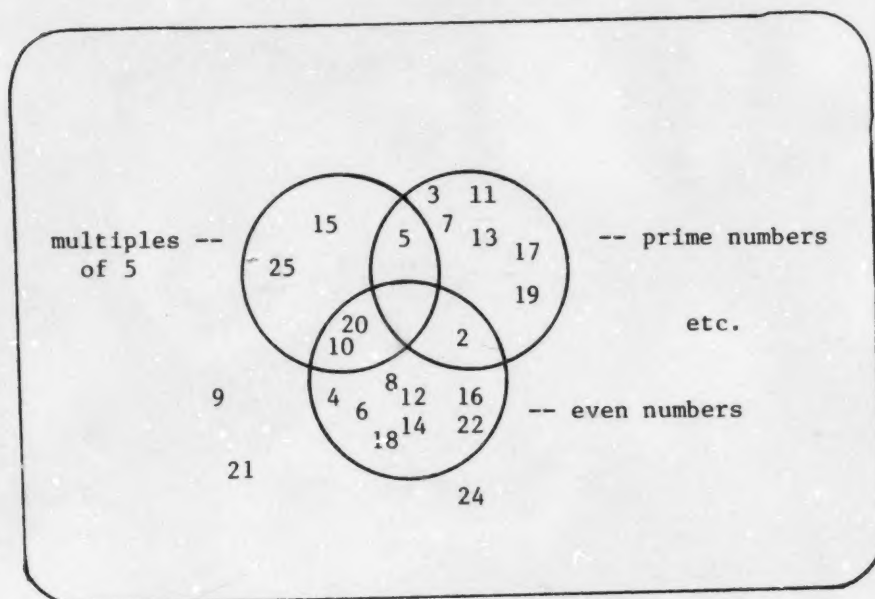
Activity 2



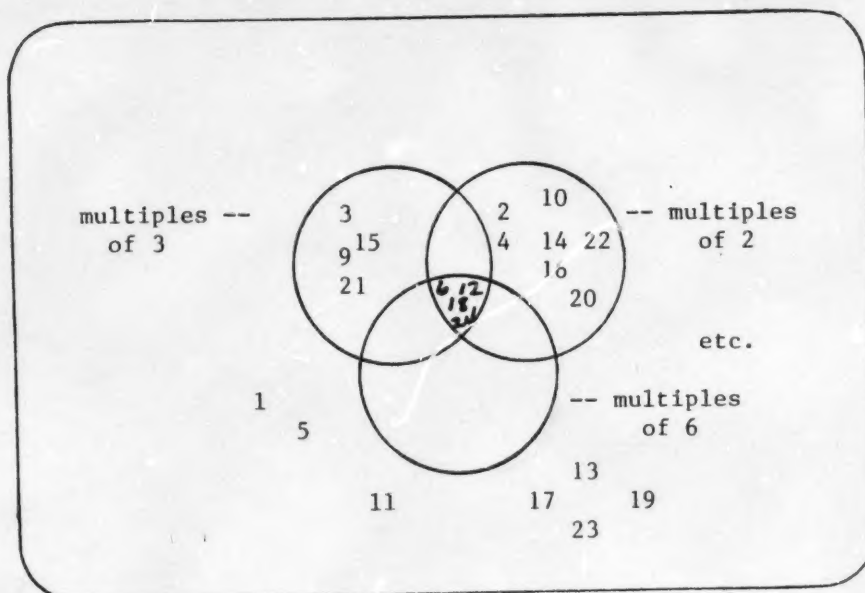
Activity 3



Activity 4



Activity 5



Label Me

Purpose: To introduce logical connectives and to develop reasoning abilities.

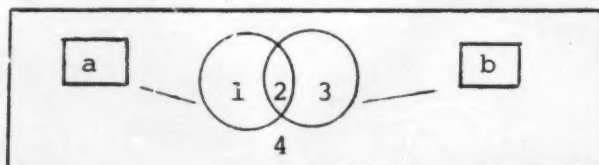
Materials: All 24 attribute blocks, I.D. cards and diagrams on pages 63-66; (or use three loops of different colored yarn or string.)

Number of players: One to several.

Make and cut out of cardboard the initial I.D. Cards I.

Place one of the cards next to the first diagram (or one loop of yarn). Suppose the I.D. card labeled "blue" is used. The children would place all the blue blocks inside the region and all of the blocks that are not blue outside of the region. After all the blocks have been placed, ask the children to describe the blocks inside the region. Then ask the children to describe those blocks outside the region. Continue to do this with other I.D. cards, eventually include those involving "not". The negative label cards make these activities more complex. It is suggested that at first they not be used, but as the students become more skillful, they be used. When the loops are labeled, bring out that every piece belongs in a specific place relative to the loops according to its attributes.

At a later time, use the second diagram (or two loops of yarn). After the children have placed all the blocks they should be asked to identify the blocks in each of the four subregions. For example:



- Subregion 1: all a that are not b.
- Subregion 2: those that are a and b.
- Subregion 3: all b that are not a.
- Subregion 4: all those that are not a and not b.

After the children are comfortable with two regions, try it with three regions. Ask questions of the 8 subregions. Note that, depending on the selection of I.D. cards, some subregions may contain no blocks. Ask the children why these subregions are empty.

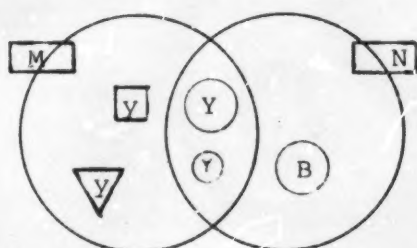
Variation: Name the Set

The teacher prepares (or a child prepares) a problem by choosing identification cards and completing the set up by correctly placing the logic blocks. The identification cards are then attached face down. The child is to discover the directions given on the I.D. cards.

By asking questions such as "Does that tell you what the I.D. card might be?" and "Which piece should you now have placed in order to determine for sure what the I.D. card says?" the students will find game strategies. The more the game is played, the more sophisticated the strategies become. "Name the Set" can

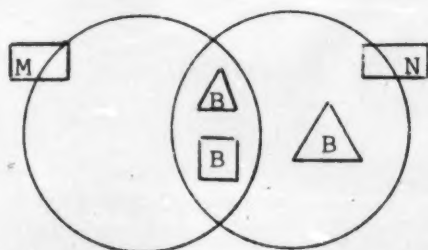
be played using a leader who secretly chooses the I.D. cards and two opposing teams that try to determine the cards. You might want to use the following examples to begin with.

Examples



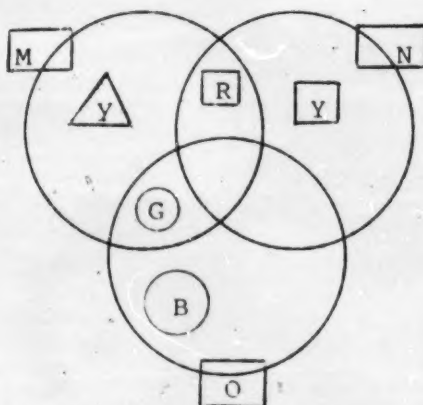
I.D. card for loop M (yellow)

I.D. card for loop N (circle)



I.D. card for loop M (small)

I.D. card for loop N (blue)



I.D. card for loop M (small)

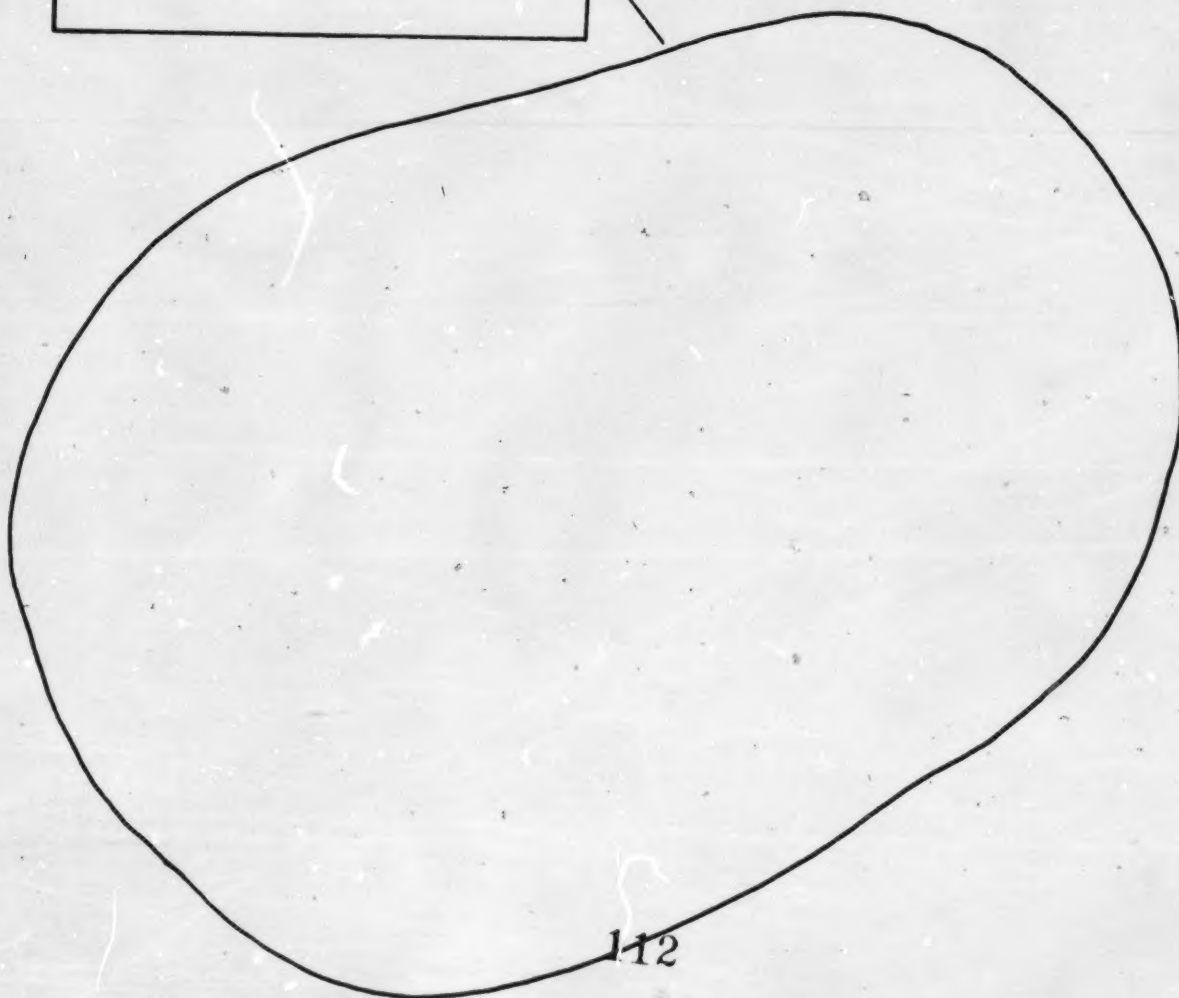
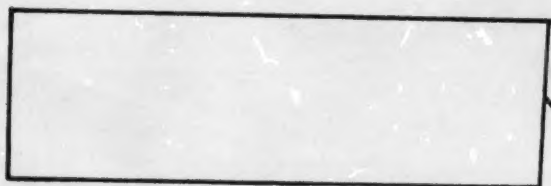
I.D. card for loop N (square)

I.D. card for loop O (circle)

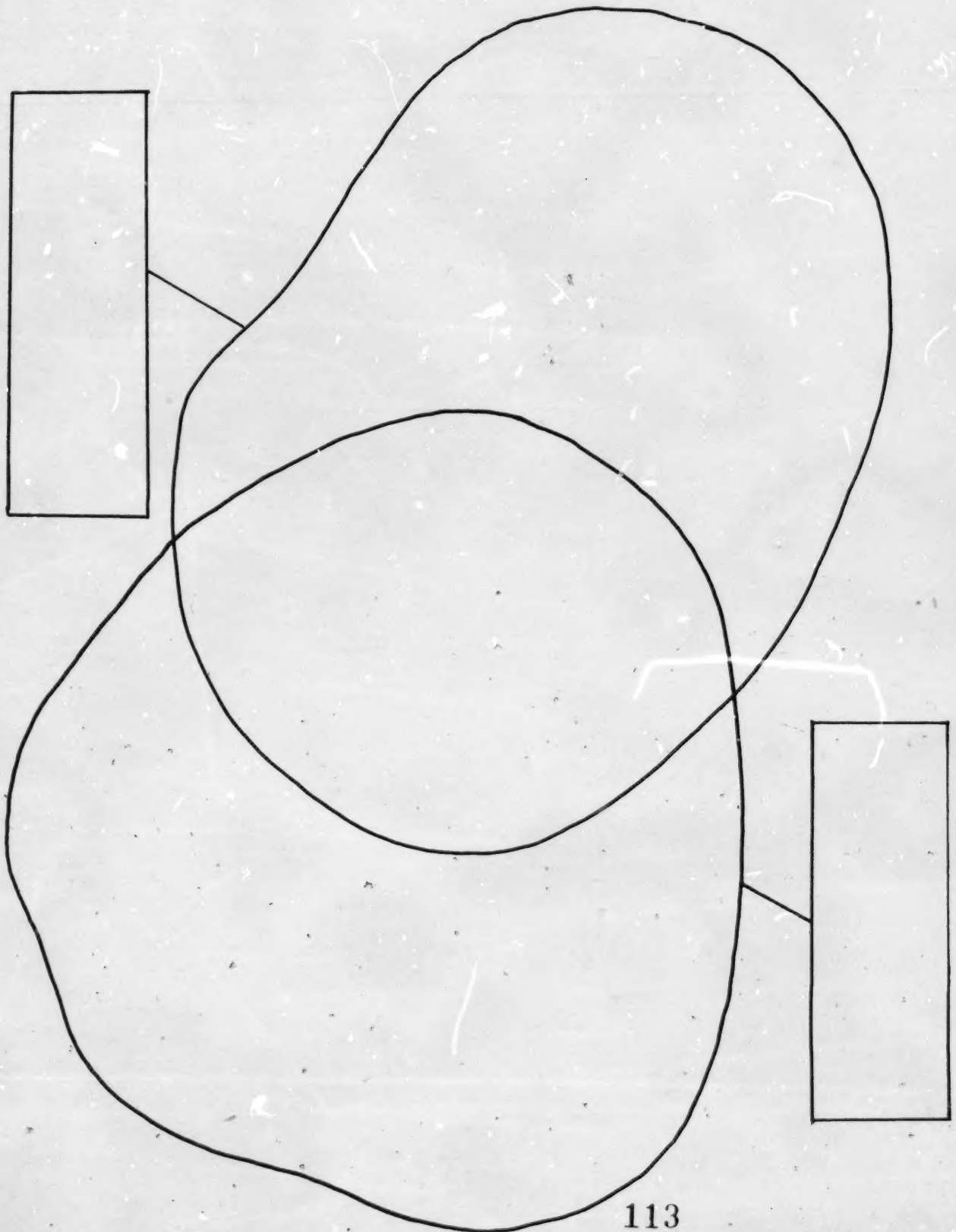
STRING GAME I

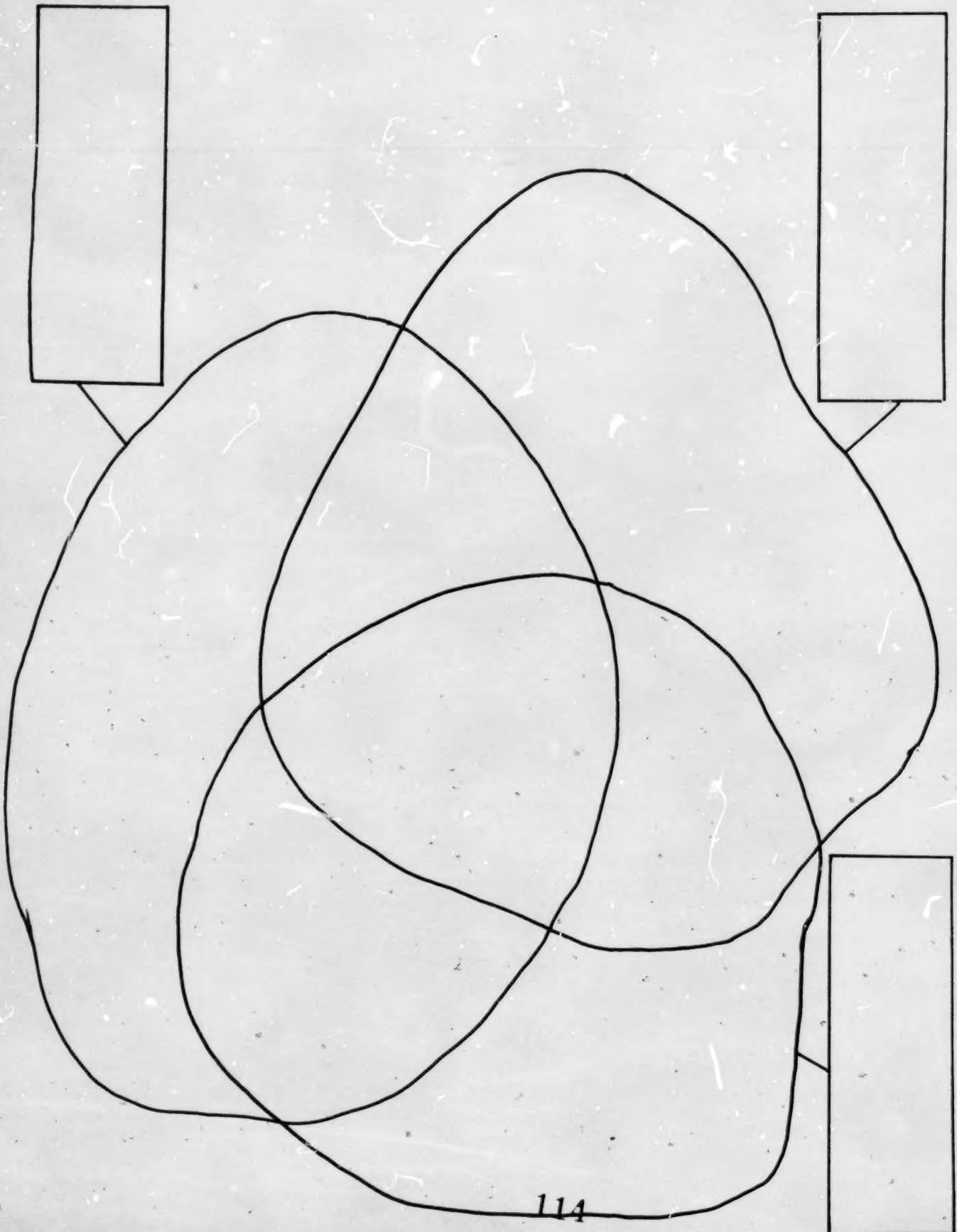
IDENTIFICATION CARDS I

LARGE	SMALL
TRIANGLE	SQUARE
CIRCLE	BLUE
GREEN	YELLOW
RED	NOT TRIANGLE
NOT SQUARE	NOT CIRCLE
NOT BLUE	NOT GREEN
NOT YELLOW	NOT RED



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Guess My Line

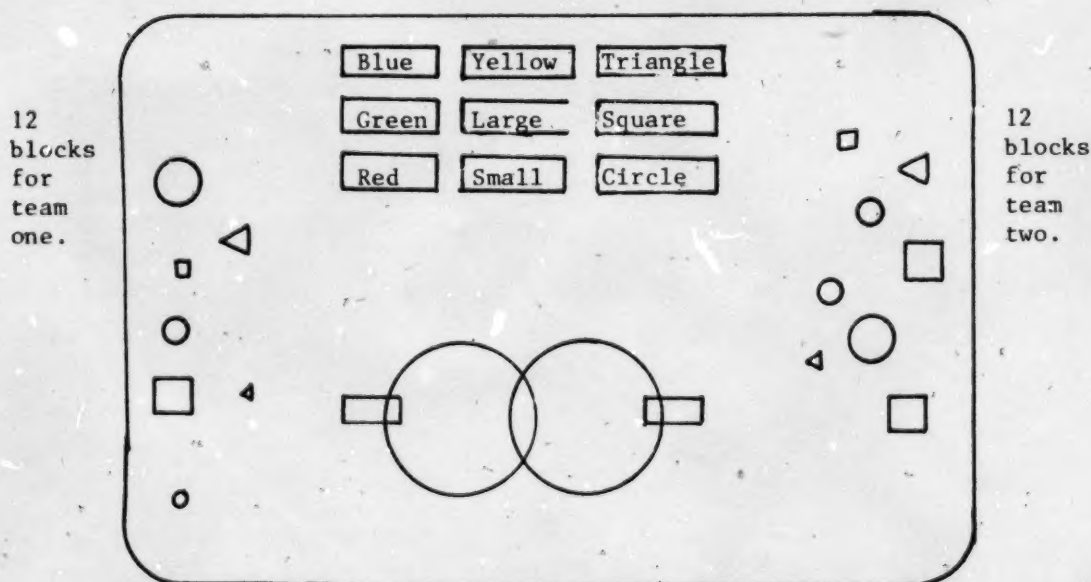
Purpose: To develop logical thinking abilities.

Materials: All 24 attribute blocks, 2 identical sets of I.D. cards on page 71, 3 different colored string loops each made from one meter of yarn.

Number of players: A small group to the entire class.

Prior to the beginning of the game, the following things should be done (see diagram below):

- a. Place on a large table, where all students can observe, two intersecting strings.
- b. Place one set of the I.D. cards face up on the table.
- c. Divide the class into two teams and have the teams stand on opposite sides of the table.
- d. Separate the 24 attribute blocks somewhat randomly into two piles, one set for each team.
- e. The teacher now takes two cards from the second deck of



I.D. cards. Only the teacher sees these cards. The two cards are now placed face down, one by each of the strings.

The object of the game is to have a team eventually identify the two I.D. cards.

The first student selects any one of his team's 12 attribute blocks and places it in any one of the four subregions (don't forget the outside subregion). The teacher responds with either a "yes" or a "no" depending on whether or not the piece belongs in that subregion (the two hidden cards determine whether or not the piece belongs). The teacher must remember what the two hidden cards are, and make his/her decision accordingly. If the answer is "yes" the student then tries to place a second attribute block. No student is ever allowed to place more than two blocks during a given turn. If the teacher says "no" (the block is not in the correct subregion) then the block is returned to the team pile. The teams alternate turns until one team has placed all their team's blocks. The student who places the last block must guess the identity of the two I.D. cards. If the student fails, the game continues. When their turn comes up again the team that failed to identify the cards the first time now has another chance. The student who would normally place a block now guesses the identity of the two cards. Note: a team member is only allowed to guess after all the team blocks have been placed. The team that correctly identifies the two cards wins.

When a student is attempting to identify the two I.D. cards, the teacher should wait until both cards have been named before saying "yes" or "no". No part answers should be allowed.

At some later time, use three strings with 8 regions or stay with two strings using the additional I.D. cards with the connective "not".

What's My Number?

Purpose: To develop logical reasoning and review number properties and facts.

Materials: Set of I.D. cards, II and III, and the 24 number cards on the following page, 2 and 3 strings.

Number of Players: A small group to the entire class.

- 1) Cut out the numbers and the identification cards or make new sets out of cardboard.
- 2) The rules are the same as in Guess My Line, except here we have a new set of I.D. cards and 24 numbers instead of the 24 attribute blocks.
- 3) Prior to the game, it might help to go through some of the string exercises suggested in Label Me using the I.D. cards II and 24 numbers.

I've Got Your Number

This game is the same as above except the I.D. cards III and the 24 numbers on page 72 are used.

IDENTIFICATION CARDS **II**

PRIME NUMBERS	EVEN NUMBERS
$\square > 6$	$\square < 20$
MULTIPLES OF 3	DIVISORS OF 24
$\square > 12$	MULTIPLES OF 5

1	2	3	4	5	6
7	8	9	15	25	24
12	17	21	29	33	14
35	42	28	10	31	20

IDENTIFICATION CARDS **III**

MULTIPLES OF 2	$\square > -10$
MULTIPLES OF 3	$\square > -50$
MULTIPLES OF 4	$\square < 10$
MULTIPLES OF 5	$\square < 50$
MULTIPLES OF 10	

-100	-80	-55	-20	-15	-12
-5	-2	-1	-6	1	10
24	7	99	45	0	105
30	15	60	40	100	27

Who's Who

Purpose: To develop deductive reasoning in a social setting.

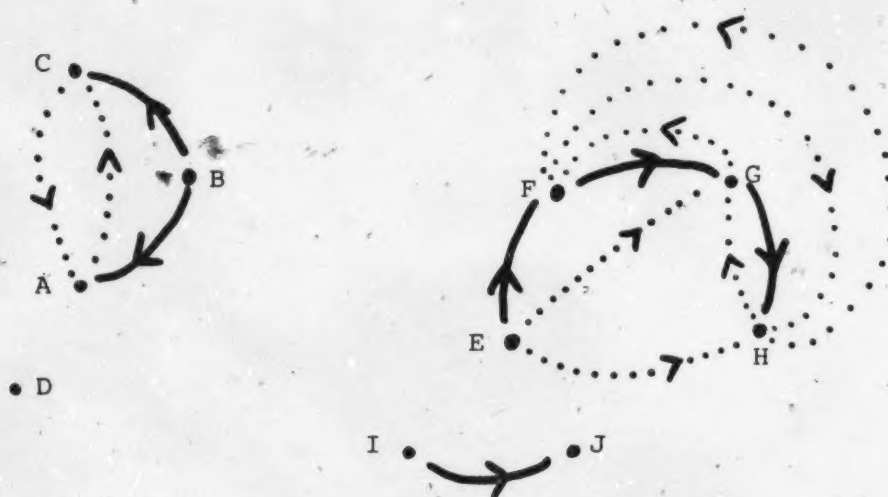
Materials: Chalkboard or handouts.

The dots represent people and the arrow indicates a relationship that exists between these persons.



You are my brother.

Using deductive reasoning, determine all of the additional arrows that may be drawn in the following situation for the relation "You are my brother." (answers in dotted arrows)



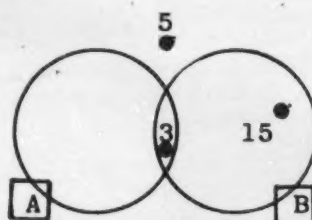
If you do everything correctly there are 8 additional arrows that may be drawn in this situation. For example, arrows can be drawn from A to C and from C to A indicating that A and C are brothers.

What's My Handle I

Purpose: To develop reasoning skills and provide practice with basic facts and processes.

Materials: Chalkboard or handouts.

The student must determine which name tags are being used to identify loops A and B. Tag A comes from the list on the left and Tag B comes from the list on the right. For Example:

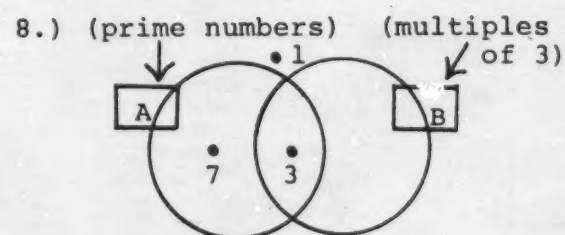
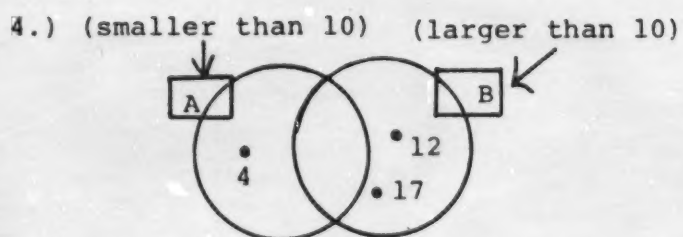
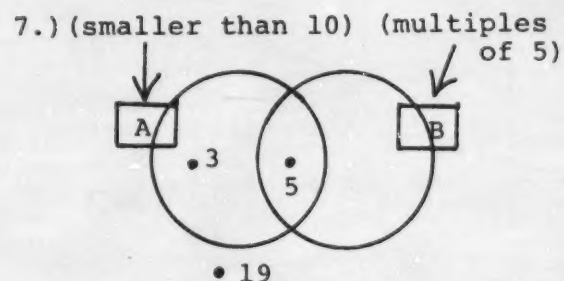
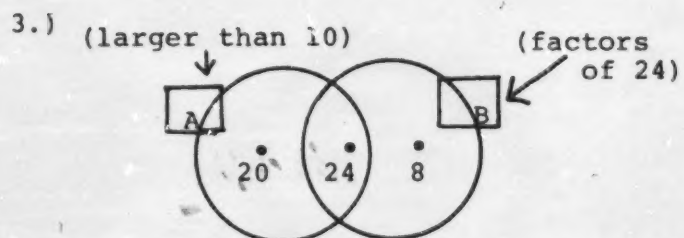
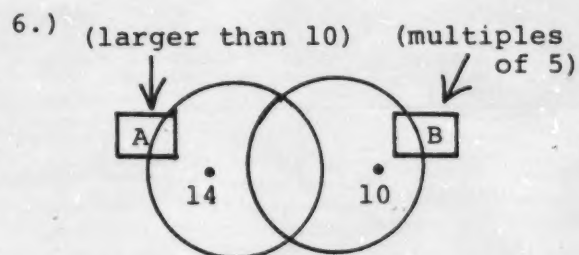
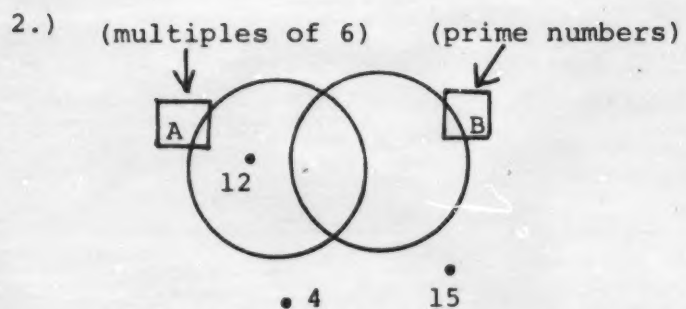
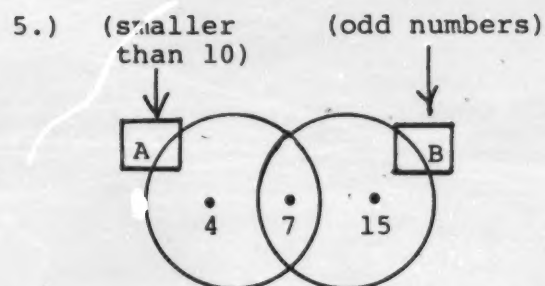
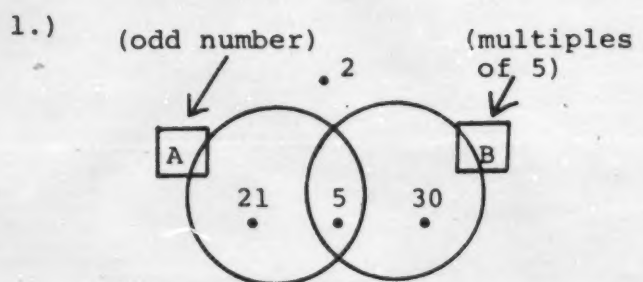


Multiples of 2
Odd Numbers
Prime Numbers
Factors of 24
Smaller than 10
Multiples of 3
Larger than 10
Multiples of 6
Multiples of 5
Divisors of 15

Multiples of 2
Odd Numbers
Prime Numbers
Factors of 24
Smaller than 10
Multiples of 3
Larger than 10
Multiples of 6
Multiples of 5
Divisors of 15

In the above example, Tag A would be Factors of 24 and Tag B would be Multiples of 3.

Make up similar problems for your students using a name tag from each list, examples follow.

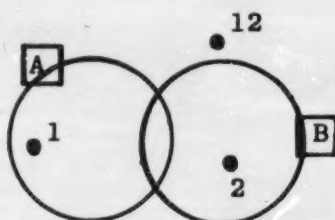


What's My Handle II

Purpose: To develop reasoning skills and provide practice with basic facts and processes.

Materials: Chalkboard or handouts.

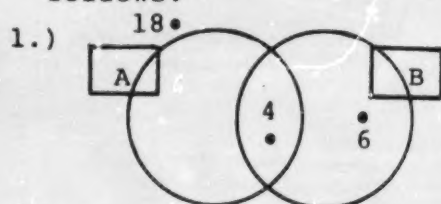
The students must determine which name tags are being used to identify loops A and B. Tag A comes from the list on the left and Tag B comes from the list on the right. For Example:



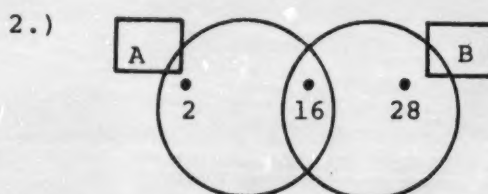
Even Numbers
Prime Numbers
Larger than 10
Multiples of 3
Smaller than 20
Divisors of 24
Divisors of 15
Multiples of 4

Even Numbers
Prime Numbers
Larger than 10
Multiples of 3
Smaller than 20
Divisors of 24
Divisors of 15
Multiples of 4

In the above example Tag A would be Divisors of 15 and Tag B would be Prime Numbers. Make up similar problems for your students using one or more name tags from each list such as follows.



(multiples of 4) (division of 24)



(smaller than 20) (multiples of 4)

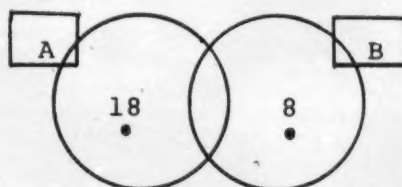
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What's My Handle III

Purpose: To develop reasoning skills and provide practice with basic facts and processes.

Materials: Chalkboard or handouts.

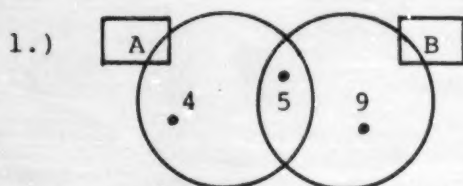
The students must determine which name tags are being used to identify loops A and B. Tag A comes from the list on the left and Tag B comes from the list on the right. For example:



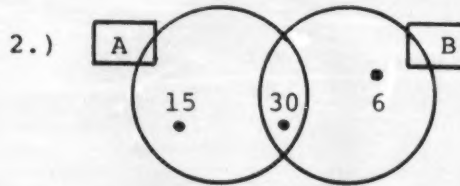
Divisors of 20
Multiples of 6
Less than 15
Greater than 8
Odd Numbers
Divisors of 18
Multiples of 5
Multiples of 3

Divisors of 20
Multiples of 6
Less than 15
Greater than 8
Odd Numbers
Divisors of 18
Multiples of 5
Multiples of 3

In the above example, while Tag B can only be Less than 15, Tag A could be any of: Multiples of 6, Greater than 8, Divisors of 18, or Multiples of 3. Make up similar problems for your students using one or more name tags from each list such as follows.



(divisions of 20) (odd numbers)



(greater than 8 or multiples of 5) (multiples of 6)

Clues Game

Purpose: To develop logical thinking and review basic arithmetic facts.

Materials: Chalkboard.

The object of the game is to identify the logic block that is being described. The clues are given to the class one clue at a time. The first person to guess the block from the clues is the winner.

Can you identify which logic block is being described by the following clues.

- | | |
|--|---|
| <p>a) It is red or it is blue
It is a circle or it is a square
It is not small
It is not blue
It is not a square
It is (<u>a large red circle</u>)</p> | <p>c) It is not a circle
It does not have four sides
It is either green or blue
It is not small
It is not blue
What is it? (<u>large green triangle</u>)</p> |
| <p>b) It is a circle or a triangle
It is blue
It is not a triangle
It is not large
It is (<u>a small blue circle</u>)</p> | <p>d) It is either a triangle or a square
It is not red and not green
It is either large or a triangle
It is not a triangle
It is either blue or small
What is it? (<u>large blue square</u>)</p> |
| | <p>e) It is small or a triangle
It is red or blue
It is not blue
It is blue or large
What is it? (<u>large red triangle</u>)</p> |

Let's play the Clues Game using numbers.

- a) I am thinking of three numbers

All the numbers are odd

None of the numbers is the same as another number

The sum of the numbers is 17

One of the numbers is three

One of the numbers is more than ten

What are the numbers? (3, 13, 1)

b) I am thinking of two numbers

Both numbers are prime

Their product is even

The largest number is 7

What is the other number? (2)

c) I am thinking of three numbers

The average of the three numbers is 8

The largest number is 13

One of the numbers is one more than the other

What are the other two numbers? (13, 5, 6)

d) I am thinking of two numbers

One is 12 more than the other

36 is eight more than the average of the two numbers

What are the two numbers? (22, 34)

e) I am thinking of three numbers

Two of the numbers are odd and one is even

The largest is ten more than the smallest

All three numbers are two digit numbers

One of the numbers is midway between the other two

The sum of the three numbers is between 40 and 50.

What are the three numbers? (11, 16, 21)

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The following were members of the Guidelines Committee for Quality Mathematics Teaching during the development of this monograph:

Donald Corbin	Detroit
Arthur Coxford (Chairperson).	Ann Arbor
Laura Davis	Detroit
Theresa Denman.	Detroit
Christian Hirsch.	Kalamazoo
Patricia Huellmantel.	Flint
David Johnson	Ypsilanti
Linda Kolnowski	Detroit
Evelyn Kozar.	Detroit
Charles Schloff	Dearborn Heights

Your comments and criticism of this monograph, as well as suggestions for other monographs (or manuscripts for them) can be sent to:

Arthur Coxford
The University of Michigan
1025 School of Education
Ann Arbor, Michigan 48109